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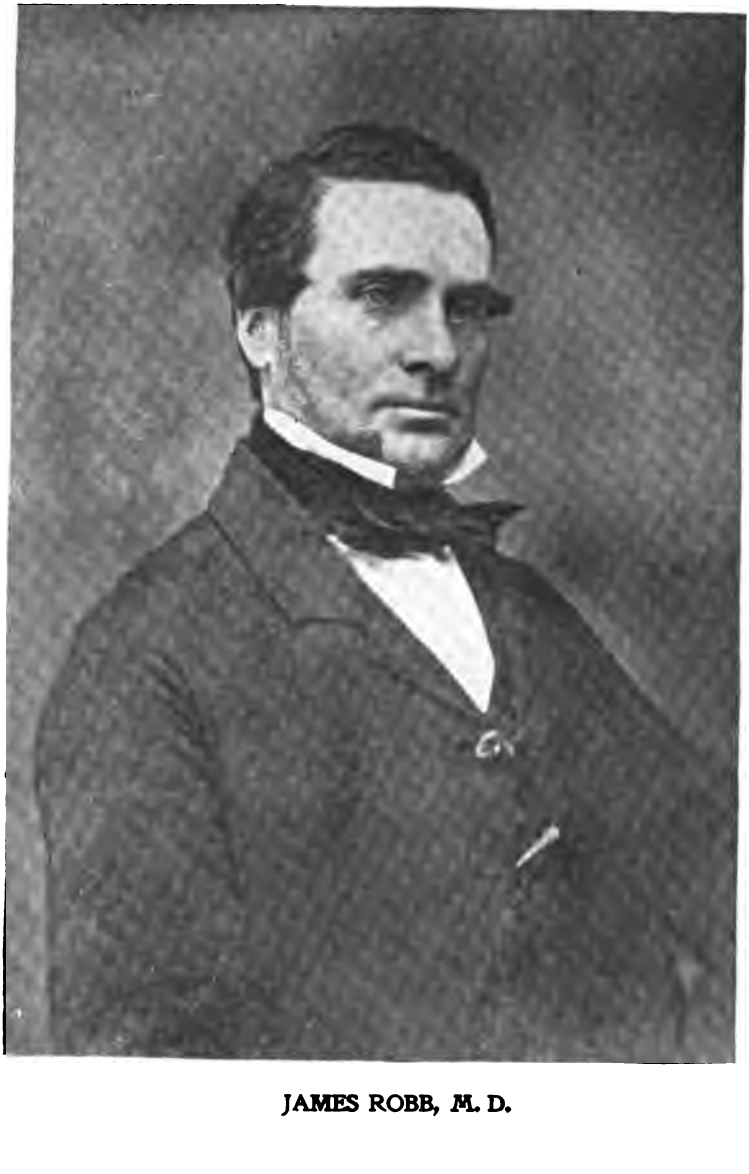

JAMES ROBB, M. D.

BULLETIN

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OF

NEW BRUNSWICK.

ARTICLE I.

DR. JAMES ROBB.

First Professor of Chemistry and Natural History in King's College, Fredericton—A Sketch of His Life and Labours,

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BY L. W. BAILEY, LL. D.

Read April 5, 1896.

In the course of the development of knowledge as regards the structure, history and natural resources of a country, it is usually the case that distinct steps of progress may be recognized, and that with each of such steps the life and labours of some one individual are prominently associated. The names of such men as Aristotle, Linnæus, Cuvier, Agassiz and Gray, make such steps of progress for the world at large, but even within the comparatively narrow limits of a single state or community a like process of development by successive, well marked stages is usually recognizable, and New Brunswick is no exception.

The first period in all such cases is usually that in which some one individual, as a result either of a more intense sympathy with nature or circumstances especially favorable for her study, devotes his whole energy to such work, and thus, by gathering and comparing the isolated and disconnected observations of many observers, begins to give to the latter a definite direction and definite methods. To us who have to labour in fields already pre-occupied by so many workers, and where the discovery of even one new fact or species is a rare occurrence, in

some departments indeed well-nigh an impossibility, a glance backward into the territories investigated by the early pioneers cannot but awaken a feeling of envy. On whichever side they turned something entirely novel was almost sure to meet their gaze. They had only to stretch out their hands and a veritable Klondyke of rich rewards awaited their grasp. No wonder that their imaginations were aroused to the highest pitch, and that conclusions and anticipations should be indulged in, which would require time and the crucible of criticism, and more exact observation to reduce to their proper value. In New Brunswick the period of pioneer exploration, and of enthusiastic but not always well justified prophecy, is identified with the name of Dr. Abraham Gesner, a sketch of whose life and labours has been published by the Society in its No. XV. Bulletin. That of the beginning of more exact observation and of critical analysis is similarly associated with the subject of the present sketch, Dr. James Robb.

Dr. Robb was born in the city of Stirling, Scotland, in the year 1815. Of his early life and education I have been unable to obtain any particulars, but, from letters written at the time, I find that he entered upon a course of medical study in Edinburgh University in the year 1831. He could hardly have ever entered seriously upon the practice of his profession, for in August of the year 1835 we find him travelling, while still a student, on the continent of Europe, and in September, 1837, he had already come to New Brunswick to accept the position of Lecturer in Chemistry and Natural History in King's College (now the University of New Brunswick), in which as Professor he continued to work until the time of his death, in 1861.

It is very evident that, even at the time of his European journey, which lasted for several months, he had already acquired a fondness for scientific, as distinguished from merely medical or professional, work, for he himself says, in writing to his mother, that the trip "was more for science than for pleasure," and resulted in the "collection of vast numbers of plants and shells and minerals." He must also have already gained for himself an enviable reputation as a naturalist, for he was accompanied by Dr. Van Beneden, already well known in the scientific world, and carried with him letters to many distinguished savants, making, as he says, the entire journey a "*voyage d' agrément.*" Switzerland would seem to have had special attractions for him, though Nice, Milan, Genoa and Sardinia were also visited. The journey was made *on foot*, and in the passage of the Juras was not unattended with danger, the party being on one occasion storm-bound for three days in

a hut on the Auberge, from which they only escaped with difficulty, and where, to use his own words, "had they been much longer confined, they would have had to eat each other, like the Kilkenny cats, because there was nothing else to eat." He grows quite enthusiastic over their reception at the University of Pavia, where, despite their clothing, much the worse for travel, "the Professors of that time-honored seat of learning vied with each other in attentions and affability, one giving us objects of natural history, another presenting us with his works, and a third giving us iced sherbets and chocolate." He would never, he says, "think of his visit to Pavia but with feelings of the highest gratification." He adds that not at Pavia only, but throughout the journey, every moment was not only pleasurable, but of inestimable value to him. He was constantly in an atmosphere of science, and as the collections then made were undoubtedly those which subsequently became the nucleus of the cabinet now in the University in Fredericton, the writer of this notice, to whom these facts have only recently become known, can now the more readily understand, as he has always been surprised at, their extent and value.

The special circumstances which led to Dr. Robb's coming to New-Brunswick are not definitely known; but as about the same time at least one other Professor from Scotland came to the Provinces for a similar purpose, it is probable that enquiries or advertisements had been instituted there with a view to the obtaining of properly qualified instructors. However this may have been, it is certain that Dr. Robb had not long been here before his influence began to be felt in the community. Accustomed to cultured society, fond of music, well read in the literature of the day, and, though not practising medicine, recognized universally as one thoroughly competent to advise, and, in the case of the poor, ever ready to give advice without compensation, he could not fail to be an acquisition to any community, and especially to such a one as then existed in Fredericton. Proofs of the estimation in which he was held are not wanting. Old residents of the city, and among all classes, speak of him even now in terms of the highest regard. His opinion was sought upon many subjects outside the line of his ordinary professional work. He was the first President and the most active spirit in the Fredericton Athenæum, a society or club for the promotion of literary and scientific research; he was nominated, in 1849, and chosen a member of the first Council of his adopted city, and again in 1850, in this latter case declining to serve that he might be the more free to give his attention to what he conceived to be a

still more important duty—the promotion of the agricultural interests of the Province. He enjoyed in an eminent degree the confidence of the then Lieutenant-Governor of New Brunswick, Sir Wm. Colebrook, as also that of the Bishop, the Chief Justice, the Master of the Rolls, and the other chief officials of the colony. As a teacher he was loved as well as respected by his pupils, seeking always for accuracy and clearness of statement rather than for a show of words, and endeavoring, as far as his very isolated position and remoteness from books and fellow-laborers would allow, to keep himself acquainted with the latest results of scientific thought and experiment. In December, 1840, he married Miss Ellen Coster, daughter of the Archdeacon of New Brunswick, and from that time his residence in the College building was a centre from which he continued to influence for good a constantly widening circle of individuals and of interests.

We, as naturalists, are chiefly concerned with his scientific labours. As might be expected, the natural products of a country quite new to him were quick to attract his attention, and the dates attached to specimens in the college herbarium show how soon after his arrival he entered upon the study of the botany of the Province. Practically he was our first botanist, for though others had made a few scattered observations on the occurrence of particular species, he seems to have been the first to attempt anything like a systematic collection. This collection is now in the museum of the University of New Brunswick, and embraces several hundred species, some of them forms of very rare occurrence, and some species re-discovered long afterwards by other observers. It was, of course, arranged on the old Linnæan system, but both in its extent and in the accuracy of its determinations shows clearly the labour expended upon its preparation. It is to be regretted that in this, as in so many other instances, the results of his work were never printed, so that little besides the collections which he made remains to indicate the extent of his services. He must, however, have maintained correspondence and exchanged specimens with naturalists abroad, as along with his own collection are many specimens sent from the herbaria of Messrs. Hooker and Balfour. He must also have continued to enjoy an enviable reputation among the botanists of the motherland, as his letters indicate the interesting fact of his having been suggested as a possible successor to Sir W. Hooker in the botanical chair in Glasgow, a position which, however, he says that he could not, in view of his engagements here, honourably accept.

A study of the wild plants of the Province was accompanied by an interest in the cultivated forms and in the conditions of their production. In April, 1850, having refused to be elected to the Fredericton City Council, he took hold of a Provincial Society for Encouragement of Agriculture, which, he says, "gave him more to do than the Council." He was elected its president, and soon after wrote a paper on the subject of Manures, which, with others, was afterwards printed, though no copies, so far as known to the writer, are now extant. Practically, he became Secretary of Agriculture for the Province, an office not actually established until a much later period, retaining the position until his death, and in that capacity visiting many parts of the Province, giving frequent lectures on agricultural subjects, and correlating the statistical returns submitted to him by his many correspondents. I have before me his lecture, "On Agricultural Progress in New Brunswick," and find it to be a model of terse statement, extended observation, careful criticism of existing methods, and sound judgment in the direction of possible improvement. The government of to-day could not do better than to have this lecture reprinted and widely circulated among the class for whom it was chiefly intended.

Such a man as Dr. Robb would of course naturally understand the intimate relationship between the nature of soils and that of the rocks from which they are derived. His interest in geology had, moreover, already been aroused by his European tour, the fruits of which were before him, and no doubt employed in the illustration of his daily lectures. We may be sure, therefore, that it was with no indifferent eye that he scanned the results of the geological survey begun by Dr. Gesner in 1837, and continued during the four following years.

In the commencement of this sketch it was stated that Dr. Robb represents the second period in the history of scientific progress in New Brunswick. Strictly speaking, he and Dr. Gesner were contemporaries, but the first published observations of Dr. Robb, of a geological nature, are subsequent to those of Dr. Gesner, and are largely in the direction of criticism of the latter,—criticisms, however, based on his own personal observations and evidently having no other object than that of reaching more reliable conclusions. These criticisms are mostly contained in the report of Prof. J. W. F. Johnston on the Agricultural Capabilities of New Brunswick. Dr. Robb here especially objects to the enthusiastic and in many instances grossly exaggerated

statements of Dr. Gesner, relative to the occurrence of coal, and shows, by reference to all known outcrops, that the coal field of New Brunswick, instead of being one of the largest discovered on the globe, as stated by Gesner, was really small as compared with those of Illinois and Pennsylvania, and that the coal supply, instead of being "inexhaustible" and "of the highest importance not only to New Brunswick but to Great Britain and the United States," was really very small, the only workable seam known, and that of limited extent (the Grand Lake seam), not exceeding eighteen or twenty inches.

Another point in which Dr. Robb took issue with Dr. Gesner, of less economic significance, but still involving important consequences, was that of the true stratigraphical position of the red saliferous and gypsiferous rocks which cover such large areas in southern and some parts of northern New Brunswick. These, on account of their lithological resemblances to the rocks of the New Red Sandstone formation of England, with which he was familiar, were asserted by Dr. Gesner to be newer than the Coal formation, whereas Dr. Robb, following the view of Sir Charles Lyell, maintained, and correctly, that the greater part of them are really older than the coal measures.

But the most important contribution in this direction made by Dr. Robb is that of a Geological Map, contributed to Prof. Johnston's Report, in which, taking Dr. Gesner's incomplete maps as a basis, but modifying them as influenced by his own observations, as well as by those of Jackson, Logan and Lyell, he makes a distinct advance in the representation of the geological structure of the Province. With characteristic modesty, however, he observes that the map, made at Prof. Johnston's request, is unsatisfactory to himself, and is offered with very great diffidence.

In a sketch of the scientific work of Dr. Gesner, prepared by Dr. G. F. Matthew, and published in a Bulletin of this Society (No. XV, 1897), a very full discussion of the former's view is given, together with a representation of his map reduced from the map in the hands of the Natural History Society of New Brunswick, showing the result of his first three years' survey, and the more complete one in the possession of the Crown Lands Department at Fredericton, which shows also the work of his fourth year. Unfortunately we are without any record of Dr. Robb's observations and conclusions, excepting the very brief observations embraced in the letter to Prof. Johnston accompanying his own map. We are therefore limited to a

mere statement of the differences presented by the latter, as compared with the earlier map of Gesner, on which it is avowedly based.

The first feature to attract attention in such comparison is the larger area embraced in the map of Dr. Robb, the latter including the whole Province, while that of Gesner did not extend, except along the St. John river, north of a line connecting Woodstock and Chatham. Gesner's map, however, represents the results of his first four season's work only, while in the following year he made explorations of the northern counties sufficient to indicate their general character, and it is upon these, no doubt, that the completion of the work by Dr. Robb is based.

In his representation of the distribution of the granites which are so conspicuous a feature in the geology of New Brunswick, Dr. Robb's map—at least as regards the southern part of the Province—is less fortunate than that of Dr. Gesner, the more recent explorations embodied in the maps of the Geological Survey showing, especially in Charlotte County and Western Kings, a much closer approximation to the outlines as given by the latter than to those of the former. Gesner also indicates the existence of an axis of such rock extending from the Kennebeccasis River, near Hampton, to Eastern Albert, which in the map of Dr. Robb is represented by a corresponding band of "Trap, Syenite, Felspar Rock and Porphyry." As a matter of fact, this ridge includes but little true granite.

The northern granite belt, represented in Gesner's map only between the St. Croix River and the St. John, in that of Dr. Robb is extended across the Province to Bathurst. The granitic area of the Serpentine is also indicated.

The including of so many different rocks under a common colour, irrespective of age or origin, as in the case of the Trap, etc., referred to above, is, in the maps of both authors under review, an unfortunate feature, but is far more conspicuous in that of Dr. Robb than in that of his predecessor, the former being in almost all parts, not occupied by the coal-formation or red sandstones, blotched with small patches represented as occupied by one or other of these rocks, and which include intrusives of every age from the Laurentian to the Trias.

As regards the earlier Palæozoic rocks, the two maps differ widely, the Cambrian system being made, in that of Dr. Robb, to include large portions of Charlotte and Kings Counties, which in that of Dr. Gesner are represented as granitic or trappean, while the great band of slates and quartzites north of the York County granites, and includ-

ing the area about Woodstock, represented by Gesner simply as clay slate or argillites, and differently marked from that of the similar belt south of the granite, is by Robb, and correctly, made of the same age as the latter. It is probable that in referring both of these great belts, which are more or less metalliferous, to the Cambrian system, Gesner and Robb were, upon the whole, more correct than the officers of the Geological Survey so many years later.

In Gesner's map a considerable belt of rock skirting the southern seaboard from Passamaquoddy Bay to Chignecto Bay, and now known to be Pre-Cambrian (Laurentian and Huronian), is referred to the Lower Silurian, or its supposed equivalent, the Graywacke System. This, undoubtedly the oldest group of rocks in the Province, and a part of the Acadian protaxis, is by Robb made still younger, or Upper Silurian, possibly through the knowledge of the occurrence of Upper Silurian shells in some of the areas, such as Passamaquoddy Bay, where they are to some extent associated with and overlie the beds of the older system ; or, the fact that such Upper Silurian rocks had been shown by Jackson to occupy large areas along the coast of Maine, rendered it probable that the apparent extension of these in New Brunswick should be referable to the same horizon. The Upper Silurian rocks of Northern New Brunswick, not indicated in the incomplete map of Dr. Gesner, are by Dr. Robb clearly distinguished, the lines representing its southern margin showing a somewhat close approximation to their true position as determined by later investigation. On the north the border is made to exclude Temiscouata Lake, of which the greater part is really bordered by Silurian strata.

In this connection the following extract from a letter of Sir Wm. Dawson to Mr. S. W. Kain, in answer to certain enquiries of the latter, will be read with interest :

As stated in Acadian Geology, p. 502, the first fossil plant seen by me from the Devonian of southern New Brunswick was a Calamite (C. *radiatus* Brongt. *C. transitionis* Goept.), afterward illustrated by many specimens from the vicinity of St. John. This specimen Dr. Robb brought to Montreal, I think, at the time of the meeting of the American Association here in 1857. At the time these rocks near St. John were supposed to be Lower Silurian, and the Calamite showed that there must be newer beds there, though it was a species not found in the coal formation. I suggested at the time to Dr. Robb that on his return he should endeavour to ascertain if other fossil plants were present, and what portion of the slates and sandstone rocks near St. John contained them. This he proposed to do, but did not live to carry out his intentions, and the work fell into the hands of Messrs. Matthew and Hartt, by whom it was so successfully carried out. I did not know if Dr. Robb had any conference with

these gentlemen on the matter; but after his death I know I encouraged them to collect, though I had no idea of the rich results that were to reward their researches, and especially those of Mr. Matthew.

Sir William goes on to say: "I regarded Dr. Robb as an accomplished geologist, though I often regretted that the pressure of educational and other work, and perhaps his own quiet and retiring disposition, prevented him from cultivating more extensively the field for original research presented to him in New Brunswick."

In this connection it is gratifying to know that one of the largest and most abundant of the fossil plants found in the Fern Ledges at Carleton is a *Cordaites*, bearing the specific designation of *C. Robbii.*

No Devonian rocks, as such, are distinguished in the map of Dr. Robb, those of the vicinity of St. John and Lepreau being included in the supposed Upper Silurian area, while those of Passamaquoddy Bay (St. Andrews' peninsula) are, not unnaturally, associated with the red rocks of Kings and Westmorland and Albert, under the lithological designation of "Red Sandstones," etc. These, as already stated, were by Gesner regarded as newer than the coal formation, while by Robb they were looked upon as being beneath the latter, and "of the age of the mountain limestone, or perhaps of the Devonian strata. As it is now known that these "red sandstones," etc., include not only the equivalents of the mountain limestone and other lower carboniferous strata, but the Devonian plant-bearing beds of Perry, Maine, and those which, on the Bay Chaleur, hold remains of *Coccosteus*, *Pterichthys*, and other fishes of the old red sandstone type, it will be seen that Dr. Robb's anticipations in this respect have been fully confirmed. It is to be noticed, also, that the area assigned to these red rocks in Albert and Westmorland Counties is greatly reduced in the map of Dr. Robb, the districts thus represented being referred, though not with strict accuracy as to limits, to the coal formation.

The Lower Carboniferous outlier of the Tobique Valley is correctly indicated, though not definitely referred to this formation.

With the exception above referred to, the tracts assigned to the coal formation, as outlined by Dr. Robb, agree with those of Dr. Gesner and with the results of later observations. In their estimate, however, of the productive capacity of the coal field, the views of the two authors differ widely, those of Dr. Robb being far more moderate, and, as now believed, much nearer the truth.

It has been already stated that the red sandstones, etc., regarded by Dr. Gesner as "New Red," were by Dr. Robb referred to a Lower

Carboniferous or Devonian horizon. The existence of true Triassic beds, occupying as they do extremely limited areas on the coast, and not readily distinguished from associated Carboniferous strata, do not appear to have been known to him. The accompanying traps, with those of Grand Manan, are not, in the maps of either author, distinguished from other eruptives or assigned to any definite period.

Upon the whole, the map of Dr. Robb, though confessedly based upon that of Dr. Gesner, shows the results of extensive original observation and reflection, and though in some instances, as stated, less correct in its representations than the former, shows a decided advance in the direction of sound views and more exact limitations. It was the first published geological map of New Brunswick, and, so far as this Province was concerned, was reproduced, without essential change, in that accompanying the first edition of the "Acadian Geology" of Sir William Dawson.

Another, among the comparatively few instances in which Dr. Robb gave public expression to his views upon geological subjects, was in connection with the celebrated controversy as to the nature and origin of the mineral *Albertite*. The question having arisen as to whether this was to be regarded as coal or asphalt, or a variety of either, a question involving, in connection with the then existing mining laws, the ownership of a property of enormous value, experts were brought forward, in several instances from considerable distances, the consideration of whose testimony made the trial a very lengthy one, at the same time that it tended to extend very greatly the knowledge of the class of substances of which Albertite may be regarded as the type. On the one hand Dr. Chas. T. Jackson, of Boston, and his associates, maintained that the mineral was a true coal, while Prof. Richard C. Taylor, in association with Dr. Robb, asserted that it was either asphalt or a variety of asphalt. The published deposition of Prof. Taylor, on behalf of Dr. Gesner, the claimant, contains many interesting observations on the geology of the vicinity of Hillsborough, as well as regards the peculiarities of the Albertite deposit, all of which he states were made in company with Dr. Robb.

The final decision of the jury hinged, by the direction of the judge, simply upon the question whether Albertite was a *mineral* or not, and, there being no real doubt upon this point, was given in favor of the defendants. It is, however, interesting to observe that, as regards the real nature and origin of the material, the views of Taylor and

Robb have in every particular been confirmed by the results of later investigation. The very recent discovery of Albertite veins penetrating the pure white gypsum or alabaster deposits of Hillsborough, is a singular commentary upon the views that the mineral in question is a *coal*.

It has been said that Dr. Robb's published observations are but few. But important as these are, we should form a very inadequate idea of the man and of his work if we restricted our estimate to these only. In reality his researches took many different directions, and, had his manuscript notes, after his death, not unfortunately gone astray, their publication would have been a source of much valuable information. This is especially true of researches made by him in regard to the early occupation of the country by the French, as well as regards the language and traditions of the still earlier Indian tribes.

In referring to these manuscripts Rev. W. O. Raymond, in whose keeping they now are, says in a letter to the writer:

After the attempt by Peter Fisher in 1825, of Alex. Wedderburn in 1836 Moses Perley in 1841, Calvin Hatheway in 1846, and Abraham Gesner in 1847, to give something of the history of the Province, Dr. Robb seems to have formed the design of writing a history of a more elaborate kind, embracing the Acadian period as well as the history of the Pre-Loyalist English settlements and the later history. To this end he compiled, from time to time, such materials as he could glean from Champlain, Charlevoix and other French writers, and also from certain documentary materials in Halifax and Massachusetts. The manuscript books in which the result of his researches are to be found are interesting. They contain many corrections, interliniations, and on the pages opposite to the ink-written narrative, many supplementary notes in pencil, and observations which go to show that the work was regarded by him as of a tentative nature.

There is also among the Robb papers a lot of Indian words with observations on the same, and rude attempts at classification. In nearly all the papers one is struck with the industry that Dr. Robb displayed, and although he did not live to complete his historical work sufficiently for publication, he was following the right path, and really, with the time and opportunities afforded, he accomplished a good deal. Modern students of provincial history have fuller and better sources of information than had he, and I do not know that his manuscript contains much that is *original*, which is to be regretted.

The museum which Dr. Robb founded in connection with King's College (now the University of New Brunswick) is well worthy of notice. It has been already said that during his European tour Dr. Robb embraced every opportunity to make collections of minerals, rocks, fossils and plants. From the nature of the collections now in

the college, it is quite evident that the larger part of this material was brought with him across the Atlantic, though it may possibly have been supplemented by orders subsequently given. In particular may be mentioned a collection of European fossils, several hundred in number, all duly named and classified, similar collections of minerals and rocks, partly from the continent and partly from Scotland, examples of slags and furnace products, models of iron and soda furnaces, specimens of moulds and utensils employed in the manufacture of china and porcelain, Sopwith's geological models, glass models of crystals, etc., etc. In the botanical department, besides numerous flowering plants, are many specimens of mosses, lichens, ferns and seaweeds, also identified and classified.

Dr. G. F. Matthew tells me that he remembers Dr. Robb very well, and when the former began to study mineralogy he received much assistance and advice from Dr. Robb. This could only be on the rare occasions when Dr. Matthew visited Fredericton and had time to go up to the college. Dr. Robb took great pleasure in showing and explaining the collections in the museum, among which were specimens from the copper mines of Lake Superior, including an example of quartz crystals containing native copper, which Dr. Robb exhibited as a remarkable inclusion, not easily explained. It was from him that Dr. Matthew learned that Rogers had found "Lingulæ" in the slates at St. John, and that there were obscure remains of plants at the Barrack Shore in St. John city.

A somewhat curious specimen is that of a Malay child, which is partly double, having only one face, but four arms and four legs, obtained from a sea-captain, and which so interested its possessor that he sent all the way to Paris for standard works on the subject of monstrosities. It is accompanied by a number of carefully executed drawings, which indicate not only his interest in the subject, but also his skill in the use of pencil and brush. This latter faculty is also evidenced by the large number of pictures, some in pencil, but many in water colours or oils, and embracing views of volcanoes, coral atolls, coal plants, fossil fishes, etc., besides numerous geological sections, which are still in the possession of the university, and which were evidently made by Dr. Robb for the illustration of his lectures.

A circumstance which must have greatly embarrassed him, as it has his successor, was the want of access to libraries or books of reference. This want he endeavoured to remove, as far as in his power, by additions to the college library, and a review of the works

of a scientific character possessed by the latter at the time of Dr. Robb's decease, shows with what judgment his selections were made. The extent of this collection would have been much larger had it not been for the unfortunate shipwreck, on Sable Island, of a steamer containing a large number of books, among them the publications of the Ray Society, destined for him, besides a large quantity of furniture, crockery, etc. He must also have had an extended correspondence, one proof of which is of personal interest to the writer. Soon after assuming the duties laid down by Dr. Robb, he had occasion to make a detailed inventory of the apparatus and specimens in the chemical laboratory and museum of the college, and quite early in the search was at once surprised and gratified by finding a considerable number of packages, the written labels of which were recognized as being in the handwriting of the writer's father, the late Prof. J. W. Bailey, of West Point, N. Y. They contained samples of the so-called *Fossil Infusoria*, and, as the gentleman last referred to was at that time the principal authority in America on these microscopic organisms, he had evidently been written to by Dr. Robb that the latter might thereby be the better able to identify any similar forms which he might meet with here.

Dr. Robb's choice of apparatus, like that of books, was most judicious. Nothing but the best would satisfy him, and his chemical laboratory, though small, was a model of convenient arrangement, and, for the time and place, of ample equipment. The necessities of the case made him also his own mechanic, and in one of his letters he refers to his having been required to polish and repair a lot of instruments injured in, but recovered from, the Sable Island disaster, and which he describes as a "shocking wreck." His laboratory was fully supplied with carpenter's tools, and there is no doubt that he knew how to use them. He was a good analyst, and many specimens of ores now in the university collection are accompanied by labels bearing the results of his quantitative determinations.

His association with the Fredericton Athenæum has already been referred to. In this connection he prepared and published an almanac, of which he says, in a letter to his mother, "I can tell you it cost me a good deal of work." It was issued in 1849, is a volume of 142 pages, of which the object, as avowed on the preface, was neither profit nor remuneration, but the "furnishing of a compendium of information, useful for the time and place." He adds, "In a colony like this, where as yet food for the mind is but scantily supplied, care ought to

be taken that the quality of it is good, and that the poor settler, who often has no other library than his Bible and his almanac, should find in the latter something more nourishing than the chaff of Astrology, Alchemy and Divination." With this purpose in view, there is given a vast quantity of information, including, besides the usual monthly tables and accompanying tidal and lunar changes, a most interesting synopsis of provincial chronology, revised lists of provincial latitudes and longitudes, a register of the executive and legislative departments of the government, the judicial department, the roll of barristers and attorneys, a list of clergy of all denominations, banks, public institutions, etc., etc. It contained, also, tables of exports and imports, rates of duties, abstracts of revenue returns, tables of temperature, times of the opening and closing of navigation for successive years, tables of roads and distances in New Brunswick, and rules for the calculation of interest. It was, in fact, a sort of universal gazetteer, which, in the breadth and accuracy of its information, would compare favorably with much more recent and more pretentious volumes.

It will appear, from what has now been stated, that the life of Dr. Robb, though it has left but few records in the form of published contributions to knowledge, was a very busy one, and exerted a very extended influence upon the progress of intellectual and scientific development in New Brunswick. In estimating the results of his labours we must, as with Gesner, bear in mind the fact that science in that day was, in many of its branches, and especially in geology, in its early infancy. Dr. Robb's isolated position, as has been said, also made it difficult for him to know what was being done in the way of investigation elsewhere. And, finally, the facilities for travel in the Province were far inferior to such as exist at present. Of railways there was only one, that of St. Andrews, and, speaking of the proposed construction of another, he remarks, "There is great talk of railways at present (this was in 1847), but I am doubtful. Unless there be a federal union of the provinces, I doubt whether the great line from Halifax to Quebec would pay."

Dr. Robb was a member, and in 1849 and succeeding years President, of the Fredericton Society of St. Andrews, as also member of the Church Society of New Brunswick, and in both capacities is remembered as a zealous and energetic worker.

The removal at an early age of a man of such great and varied capacity, occupying so many different positions in the community, and at the same time ever ready to give advice, professional or otherwise,

to those who needed it, irrespective of their rank in society, could hardly fail to be deeply and universally deplored. That it was so is sufficiently indicated from the following announcement of his death in the Fredericton Reporter of April, 1861 :

The sudden death of Dr. Robb, occasioned by a violent pulmonary attack, which took place on Tuesday afternoon, is an event which, while it will awaken feelings of the deepest regret in this community, will also be regarded as a public loss all over the Province. His earnest and constant devotion to the duties of his profession, his zealous attachment to the agricultural interests of the country, his high qualifications as a scholar, and his kind and affable manners as a man, have for many years been recognized and duly acknowledged by all who either had the pleasure of his personal acquaintance or who knew him only through the medium of the familiar, yet learned and useful essays with which he so frequently favored the public. It is, however, now that he has gone, that the full impression of the loss we have sustained becomes painfully evident. Every one bewails his loss; and every one, in this city especially, has good reason for unaffected sorrow."

Any one of whom the above could be written, as voicing the feeling of the community in which he lived and labored, needs no other eulogy.

The following is a list of the published writings of Dr. Robb, derived partly from Bulletin 127 (1896) of the U. S. A. Geological Survey, and in part from other sources :

1. Remarks upon certain geological features of the River St. John, in New Brunswick, with an account of the Falls upwards from the sea, which occur near its embouchure in the Bay of Fundy.
   Brit. Assoc. Rep., Vol. 10, Trans. of Sections pp. 115–118 (1841).
   Abs. Amer. Journ. of Science, Vol. 41. Pp. 55-56. 1841.
2. Encœnia oration. King's College, Fredericton. Pp. 16.
3. Report on the Agricultural Capabilities of the Province of New Brunswick. By Prof. J. W. F. Johnston. Fredericton, 1850. [This work contains a letter by Dr. Robb on the geological structure of the Province, with an accompanying geological map.]
4. Report of the New Brunswick Society for the Encouragement of Agriculture, Home Manufactures and Commerce. Fredericton, 1851.
5. Deposition of Richard C. Taylor, respecting the Asphaltum mine at Hillsborough, Albert County, N. B. Philadelphia, 1851. [This contains a joint report on the same subject by Messrs. Taylor and Robb.]
6. Notice of Observations on Drift Striæ in New Brunswick. Am. Assoc. Adv. Sci. Proc. Vol. 4, pp. 349-351. 1851.

ARTICLE II.

LIST OF RECORDED EARTHQUAKES IN NEW BRUNSWICK.

COMPILED FROM PUBLISHED WORKS AND FROM PRIVATE INFORMATION.

BY SAMUEL W. KAIN.

Read March 1st, 1898.

In recent times much attention has been given to the study of earthquakes. In the historic period a number of shocks have been felt in this Province. Information in regard to them, however, is scattered and not easily accessible. Some of the shocks have been noted only in the newspapers, and a few of the more recent, in Grand Manan, have been drawn to my attention by one of our corresponding members resident there.

The following list has been compiled for the convenience of students, both in New Brunswick and abroad, and will be found complete for all shocks recorded. The time given (unless otherwise stated) is local time. To reduce St. John local time to 75th meridian time, deduct 35 mins. 44 sec.

1663. February 5; 5.30 p. m., 8 p. m.

This earthquake was of considerable violence, and was felt throughout the St. Lawrence Valley, Acadia and New England. (*Can. Nat.*, Oct., 1860).

1755. November.

Three or four shocks are recorded as having been felt in New England and Nova Scotia (then including New Brunswick). Sir William Dawson states (*Can. Nat.*, October, 1860) that two of these shocks were violent.

1764. September 30; about noon.

In the *Halifax Gazette* (Nova Scotia), December 13, 1764, occurs the following news item: "We hear from St. John's, in this Province, that on the 30th of September last, about 12 o'clock at noon, that a very severe shock of an earthquake was felt there."

1817. May 22; 3.31 a. m.

Felt in all parts of New Brunswick. The following account is from the *Courier:* "A heavy shock of earthquake was felt in St. John on the 22nd,

31 minutes past three o'clock, a. m. It was preceded by a noise as if a gale of wind sprang up, after which the earth began to shake violently, rumbling as if heavy carriages were passing. The trembling continued 15 seconds. The air was clear, with not a breath of wind. A minute after the shock moanings were heard from the southward. The earthquake was felt at Fredericton, fully as violent as at this place. At St. Andrews the shock was severely felt; the alarm was so great as to occasion the soldiers to leave their barracks. The shock at Fredericton occurred at 3.25 a. m.; tremulous motion lasted 25 seconds; profound calm; atmosphere heavy."

The same journal has also an account of the shock as felt at Grand Manan, which is of interest: "The earthquake of 22nd May was felt at Grand Manan; occurred just before daybreak, commencing with a loud sound, at the same time a violent shaking of houses. The shaking did not continue, but the sound lasted from 30 to 45 seconds. All agree in describing the motion as violent and the sound very loud. Weather fine and serene; light wind from northward; previous day uncommonly hot."

Peter Fisher, in his *History of New Brunswick* (1825), refers to this shock in the following paragraph: "New Brunswick appears to be but little liable to the great convulsions of nature, such as earthquakes, hurricanes, tornadoes, etc. There has been but one shock of an earthquake experienced by the present inhabitants since they settled in this country (*i. e.*, 1783–1825). This shock happened on the 22nd May, 1817, at 25 minutes past 3 o'clock in the morning. The duration of the shock was about 45 seconds. It was attended with the usual rumbling noise, without thunder, the weather being serene and pleasant. The appearances, however, usually indicating earthquakes, such as fiery meteors, the uncommon brilliancy of the aurora borealis, etc., had been frequent the winter preceding."

In the journal* of Azor Hoyt, 1813–1855 (of Lower Norton, Kings Co., N. B.), the following entry occurs: "May 22nd (1817) a shock of an earthquake." This shock was felt all through the Maritime Provinces.

1824. July 9.

Severe shock felt all over the Province. —(*Can. Nat.*, October, 1860).

1855. February 8; 6.30 a. m.

Felt all over the Province; also in Nova Scotia and in parts of the State of Maine. Moderate.

Dr. P. R. Inches has placed in my hands the following note made by him at the time:

"SAINT JOHN, February 8th, 1855.

This morning at half past six o'clock several shocks of an earthquake were felt here. I was lying in bed at the time, not quite awake, when I was startled by hearing a roaring and rumbling noise as of a chimney on fire, but much louder, followed by a violent shaking of the house and bed. I at once started out of bed to see what was the matter, but could find no cause for the noise. I could not imagine what was causing it unless it was an earthquake. I got into bed and shortly after, I think in about five or

* Manuscript: in possession of Rev. W. O. Raymond, St. John.

six minutes, felt another shock, but so very slight as to be just perceptible and no more. Again a few seconds after this second shock I thought I felt another, but I was not positive. The first shock lasted forty or fifty seconds, the second about the same time. It has, I believe, been felt at Chatham, Fredericton, Dorchester, and in the State of Maine. It appears to have been felt at Dorchester more than anywhere else. Some windows in the house of the Hon. E. B. Chandler of that place were broken."

Speaking of this shock in *Acadian Geology*, pp. 39-40, Sir Wm. Dawson says: "Its point of greatest intensity appears to have been at the bend of the Petitcodiac (Moncton). At this place there were several shocks, one of them sufficiently severe to damage a brick building."

In the Journal of Azor Hoyt, the following entry occurs: "February 8th, (1855). Three shocks of an earthquake — felt all through the Province." This is the last entry in the Journal.

1860. October 17; 6.25 a. m.

Felt over a large area of Eastern Canada and the New England States. Also felt in this Province. Moderate in New Brunswick, but severe in Quebec and Ontario.

The *Morning News* of October 19th, 1860, says: "A vibration of the earth from twenty to thirty seconds in duration occurred about twenty-five minutes past six o'clock on Wednesday morning along the western side of the harbour, causing the houses to shake quite perceptibly, and in several cases awakening people from their slumbers. We do not know what distance it extended or whether it was perceived in St. John or not; but parties residing in the vicinity of Negrotown Point felt it very distinctly, as did persons living near the Asylum."

1869. October 22; 5.48 a. m.

This earthquake was of considerable violence, and was felt all through the Maritime Provinces, St. Lawrence Valley and the New England States. The reports published in our city papers describe it as the most violent shock ever felt here. It was preceded by a rumbling rushing noise like the noise of distant thunder, and then came the vibrations, or series of them, which seemed to pass away in the distance as though a wave like motion had been imparted to the crust of the earth. These vibrations appeared to be travelling nearly east and west. Houses were shaken, dishes rattled, and bells rang, and in some cases flower pots, etc., where rolled over. The shock lasted about fifteen seconds. The papers of that date (October 25th, 1869) state that the waters of lakes and streams were discoloured by the shock, and it is noticed in particular that the water of the stream at Penobsquis, which supplied the paper mill at that place, turned chalky and had not regained its clearness on the following day. It is worthy of remark that at Fredericton, in Mr. Babbit's shop, the clocks facing north-west were stopped, while those at right angles to that direction were not affected.

W. Watson Allen has given me the following note about this shock: "At Derby (Miramichi), at the Mill Pond, known as Wilson's Mills, a spring on

the west bank of the pond, before the earthquake, boiled out of the ground, rising to a height of about a foot. After the earthquake, the fountain part of the spring disappeared, although the spring itself is still there, but diminished. Mr. William Wilson, who had lived there many years, always claimed that the pond had increased in volume of water to a large extent.

"At the forks (the confluence of Cain's River and S. W. Miramichi), Mr. Jacob Layton, who had resided there continuously for a number of years, states that in the bed of the main Miramichi River, near the shore where the water was quite shallow, and on a spot of ground that he knew very well, after the earthquake there appeared a spring of boiling water, sufficient to make a commotion upon the surface. There never had been any indications of it before the earthquake."

1870. March 17; 6 to 8 a. m.

Felt at St. John and Fredericton. Light. It was at this time that a landslide occurred at Sand Point, carrying the end of the Point out into the deeper water of the harbour. Sand Point is a gravel deposit formed by the meeting of the harbour tides and the river, and is underlaid by clay. This clay had probably been eroded by the action of water, and a heavy storm the day before had hastened a condition of instability which, even without a slight earth movement, would soon have caused the landslide.

1870. October 20; 11.40 a. m.

Felt all over the Province. In the lower part of the St. Lawrence Valley it was much more violent than in New Brunswick.

Dr. Jack, of the Provincial University, at Fredericton, in a despatch to the St. John *Daily Telegraph* (October 21st, 1870), thus describes it: "It was at seventeen minutes before noon that the first shock was felt here. This lasted perhaps two seconds, and was shortly followed by another of about the same severity, which may have been the return stroke, as the interval between was not over half a minute. The motion was vibratory, and seemed to be from south to north. It was not as strong as the earthquake of last year. There was violent wind all of Tuesday afternoon and night, and this afternoon we have a heavy rain and lowering darkness." The time at St. John was accurately noted to be 11.40; at Fredericton it was 11.43.

1882. December 31; 9.56 p. m.

St. John, Rothesay, Sussex and Fredericton. Light. Two shocks felt. The following is from the St. John *Daily Sun* (January 2nd, 1883): "At four minutes to 10 on Sunday night a slight shock of earthquake was felt. In one residence on Charlotte street a vase was thrown from its stand to the floor and broken; in another house, in an opposite part of the city, all the ornaments on a Christmas tree were set swinging vigorously. The shock was also distinctly felt in Indiantown and on the other side of the harbour. It was also felt at Sussex, Fredericton, and very markedly at Rothesay."

1884. January 26.

At Rothesay. Three light shocks. Reported in *Daily Telegraph* of January 29th.

1885. June; 10 a. m.

Rothesay, Seal Cove and Southern Head, Grand Manan. Light at Rothesay, but severe at Southern Head, where several tons of rock fell from the cliffs near the lighthouse.

1896. March 22; 7.56 p. m.

This shock was felt in Charlotte and York Counties, New Brunswick, and in Washington County, Maine. The area disturbed has a diameter of about 100 miles, and lies adjacent to the shores of the Bay of Fundy and the Gulf of Maine.

By correspondence with observers at different points, I have been able to secure some notes on this disturbance.

EASTPORT, Maine.—The shock took place here March 22nd, at 7.56 (75th meridian time), and lasted four or five seconds. This office is located in the new government building, built of granite, and on a solid ledge. Still the tremor was distinctly felt throughout the building, and more so by those living in wooden houses, The shock had no perceptible effect on our barograph. It had been rising steadily since noon, and I failed to see the least deviation in the trace. D. C. MURPHY,

U. S. Meteorological Observer.

BEAVER HARBOR, N. B.—Shock slightly felt here on 22nd March at 8.45 p. m. Jar enough in some buildings to make glass rattle.

FLAGG'S COVE, Grand Manan, N. B.—A slight earthquake shock was felt here on Sunday, March 22nd. The noise was very distinct, but only lasted a few moments. It was felt all over the island at the same time as at this station. CLARA C. SEELY,

Dominion Meteorological Observer.

ST. ANDREWS, N. B.—The shock was markedly felt at St. Andrews. A well known gentleman resident there wrote me as follows: "The noise at first was very sharp and was succeeded by a gradually lessening sound, and was all over in three seconds. It occurred at 8.45 p. m."

In addition to the above places the shock was felt in all the West Isles, on the mainland northward to McAdam, some distance along the line between McAdam and Woodstock, and at St. Stephen and Pennfield.

The shock was not felt at St. John, Fredericton, or Yarmouth, N. S.

1896. May 15th; 11.00 p. m.

A light shock was felt on this date at Fredericton, along the Nashwaak Valley, at Andover, and up the Tobique Valley as far as Three Brooks. A gentleman at Fredericton, in a letter to me, described it as "one momentary concussion." Dr. Welling, writing from Andover, says: "Two

shocks from an earthquake were felt here on the night of 15th of May about 11 o'clock. I was in bed at the time and felt the bed shake and tremble. One gentleman was about retiring when he heard what he thought were horses running around the house, but when he reached the door the noise was repeated and he saw at once that it was the shock of an earthquake. It was heard at Three Brooks on the Tobique River some twenty miles distant about the same hour."

1897. January 26; in the morning.

Felt at Campobello and Deer Island. Light.

1897. January 28; 9 p. m.

A sharp shock felt at Southern Head, Grand Manan. Duration about two seconds. Mr. W. B. McLaughlan, the light-keeper, in writing, says: "It shook us up so violently that it set my dogs barking and the horse and cattle in the stable tried to break loose. I made a record of it in my journal."

1897. February 14; 9 p. m.

Mr. McLaughlan goes on to say: "On the evening of the 14th inst., about the same hour, we felt another sharp shock, but not so violent as that of January 28th.

"I am of the opinion that these shocks are of frequent occurrence in the Bay of Fundy, and aro generally thought to be the reports of cannon. I recollect that about twelve years ago the middle of next June, at 10 o'clock a. m., we felt a violent shock at this station and at Seal Cove, but the only place on the mainland that I noticed it reported was at Rothesay, Kings Co. That shock was so violent that several tons of rock fell from the cliff near the lighthouse."

1897. September 25; 1.30 p. m.

Parts of Charlotte and York counties in this Province, and in some parts of Eastern Maine. Light. Felt distinctly at Canterbury, McAdam and St. Stephen. At St. Stephen it rattled dishes, etc., and at McAdam the earth trembled as from the passing of a heavy railway train. It lasted fifteen seconds.

Not felt at St. Andrews, Eastport, or Woodstock.

1897. October 12; 10.35 p. m.

South West Head, Grand Manan. Light. "Duration about five seconds. Wind due south, strong gale and hazy weather, about two hours to high tide. Shock from southeast with a roar like a waggon over a frozen road. It shook the buildings sufficiently to alarm my watch dog." (Letter from W. B. McLaughlan).

1898. January 11; 2 a. m.

At South West Head, Grand Manan.

"We felt a sharp shock of earthquake at this place on Tuesday, the 11th inst., at 2 a. m. It sounded like a heavy explosion, Wind northeast, light, high water, clear cold weather." (Letter from W. B. McLaughlan).

The greater frequency of earthquakes at Grand Manan than at any other place in the Province is worthy of note, and it is possible that further observations may show some connection between the so-called "gun reports" (see Bulletin XIV, pp. 40–44, 1896,) and these light earth movements.

In the discussion which followed, Dr. Geo. F. Matthew said: "This part of the Bay of Fundy it remarkable for its great depth and precipitous shores. Off Brier Island the bottom descends to a depth of 100 fathoms in a distance of three miles from the outermost ledge; it is almost equally abrupt on the Grand Manan slope; the trough between is deeper than the bottom of the Gulf of Maine outside adjoining. This is the only part of the Bay of Fundy where there have been heavy outflows of trap of Triassic age on *both* sides of the bay, and the abyss between may be complementary to these ejections of lava. The weakness of the earth's crust here in Triassic times, as shown by the volcanic eruptions of that age, may not even yet be altogether removed; but the greater tendency to earthquake movements in this district may be the dying throes of the old Triassic disturbances."

ARTICLE III.

LIST OF MOSSES OF NEW BRUNSWICK.

COMPILED BY JOHN MOSER AND EDITED BY G. U. HAY.

Read October 2, 1894.

[Containing 15 new species, but several also reported by Prof. Macoun and others.]

1. SPHAGNUM fimbriatum, Wils., Gravet. Bogs and swamps, Kent County, (F's C.)[1]
2. S. strictum, Lindb. New Mills, Restigouche, (Hay). Peat bog, Kingston, Kent Co. (F's C.) Canaan Forks,[2] Queens Co. (Moser). Herb.
3. S. fuscum, Schimp. Grand Lake. (F's C.)
   Var. fuscescens. Swamps, Bass River,[3] Kent Co. (F's C.)
4. S. acutifolium. Common. Herb.
   Var. rubrum. Common. Herb.
   Var. versicolor. (F's C.)
5. S. rubellum, Wils. Peat bogs, Kingston, Kent Co. (F's C.)
6. S. recurvum, Russ. Swamps, (Moser). Herb.
   Var. mucronatum. Grand Lake. (F's C.)
   Var. amblyphyllum. (F's C.)
   Var. parvifolium. Indian Harbour, Halifax Co., N. S. Swamp, Canaan Road, Kings Co. (Moser). Herb.
7. S. cuspidatum, Ehrh. Nashwaaksis, York Co. (Moser). Herb.
8. S. squarrosum, Pers. Tay, York Co. (Moser). Herb.
   Var. spectabile. Grand Lake. (F's C.)
   Var. semi-squarrosum. (F's C.)
9. S. wolfianum, Girg. (Moser). Herb.
10. S. rigidum, Schimp. Var. squarrosum. Peat bogs, Kingston. (F's C.) (Moser). Herb.
11. S. subsecundum, Nees. (F's C.) Wet woods. (Moser). Herb.
12. S. imbricatum, Hornsch. Var. affine. Bogs (Moser). Herb.
13. S. papillosum, Lindb. Bog, Salem, Kings Co. (Moser). Herb. Lily Lake, St. John. (F's C.)
14. S. cymbifolium, Ehrh. Common. Herb.
    Var. laeve. (Moser). Herb.
15. S. tenellum, Ehrh. Peat bog, Kingston, Kent Co. (F's C.)

1. F's C (Fowler's Catalogue) published in 1878. Herb. (Herbarium of Natural History Society of New Brunswick.)
2. As most of Mr. Moser's plants were collected at Canaan Forks, Q. Co., the name of this locality is omitted before "Moser" throughout this list.
3. As most of Prof. Fowler's mosses were collected at Bass River, Kent County, the name of this locality is omitted before F's C. throughout this list.

16. S. medium, Limpr. Var. laeve, forma purpurascens. (F's C.)
Var. roseum. Grand Lake. (F's C.)
17. WESIA viridula, Brid. Shelf of rock, Tay, York Co. (Moser). Herb.
18. DICRANODONTIUM pellucidum. Wet bank, Tay, York Connty. (Moser). Herb.
19. TREMATODON ambiguum, James. Tay and Nevers' Rapids, Queens Co. (Moser). (F's C.) Herb.
20. DICRANELLA crispa, Schimp. Common. (Moser). Herb.
21. D. squarrosa, Schimp. Shore of Washadamoak, Queens Co. (Moser). Herb.
22. D. cerviculata, Schimp. Damp earth, Carleton Co. Rotten wood, St. John. (F's C.) Gravelly bank near spring, Tay, York Co. (Moser). Herb.
23. D. varia, Schimp. Face of cliff. (Moser). Herb.
24. D. rufescens, Schimp. (F's C.) Road-sides. (Moser). Herb.
25. D. subulata, Schimp. Kouchibouguac. (F's C.) Red Bank, Tay. (Moser). Herb.
26. D. heteromalla, Schimp. Road-side, banks, common. Herb.
27. DICRANUM montanum, Hedw. Rotten wood, common. Herb.
28. D. fulvum, Hooker. Boulders, damp woods. (Moser). Herb.
29. D. viride, Schimp. On old trees, common, but always barren. Herb.
30. D. flagellare, Hedw. On rotten wood, common. Herb.
31. D. scoparium, Hedw. Common. Herb.
Var. nigrescens. (Moser). Herb.
32. D. fuscescens, Turn. Common on old logs. Herb.
33. D. undulatum, Turn. Grand Lake, Q. Co. (F's C.) Madawaska and Tobique. (Hay). (Moser). Herb.
34. D. Bergeri. Wet woods, Kent Co. (F's C.)
35. DICRANODONTIUM longirostre, Bruch and Schimp. On boulders, Tay. (Moser). Herb.
36. FISSIDENS adiantoides, Hedw. On rocks, St. John. (F's C.)
37. F. osmundoides, Hedw. Rough Waters, near Bathurst. (F's C.)
38. LEUCOBRYUM vulgare, Hampe. (Moser). Herb.
39. CERATODON purpurens, Brid. Very common. Herb.
40. DISTICHIUM capillaceum, Bruch and Schimp. Tete-a-Gouche Falls. (F's C.) Wet cliff, Long Rapids, Washadamoak Lake. (Moser). Herb.
41. Blindia acuta, Bruch and Schimp. Washadamoak, Q. Co. (Moser). Herb.
42. DIDYMODON rubellus, Bruch and Schimp. On rocks and earth, Tobique River. (Hay). (Moser). Herb.
43. LEPTOTRICHUM tortile, Muell. On old roots, Washadamoak. (Moser). Herb. (F's C.)
44. L. vaginans, Lesq. and James. Road-side, Kent Co. (F's C.)
45. BARBULA tortuosa, Web. and Mohr. (F's C.) On rocks, Tobique River. (Hay). (Moser). Herb.
46. B. unguiculata, Hedw. Common on earth. (F's C.) (Moser). Herb.
47. GRIMMEA conferta, Funck. (Moser). Herb.
48. G. apocarpa, Hedw. On rocks, St. John Co. (F's C.) (Moser). Herb.
49. G. rivularis. Fredericton. (F's C.) (Moser). Herb.
50. G. gracilis. Dry rocks. (Moser). Herb.

51. RACOMITRIUM fasciculare. On rocks, McDonald's Brook, Forks Stream and Tay. (Moser). Herb.
52. R. microcarpum, Hedw. Rocks, Forks Stream. (Moser). Herb.
53. HEDWIGIA ciliata, Ehrh. On rocks, common. Herb.
54. AMPHORIDIUM Lapponicum, Schimp. Long Rapids, Q. Co. (Moser). Herb.
55. ULOTA Ludwigii, Brid. On old trees, common. (F's C.) (Moser). (Hay). Herb.
56. U. crispa, Brid. On trees, common. Herb.
57. U. crispula, Brid. On birch trees. (F's C.) On trees. (Moser). Herb.
58. ORTHOTRICUM speciosum, Nees. On trees. (F's C.) (Moser). Herb.
59. O. sordidum, Sulliv. and Lesq. On trees. (F's C.) (Moser). Herb.
60. O. Ohioense, Sulliv. and Lesq. On trees. (F's C.) (Moser). Herb.
61. O. strangulatum, Beauv. On trees. (F's C.)
62. O. obtusifolium, Drumm. On poplar trees. (F's C.) (Moser). Herb.
63. ENCALYPTA Macounii, Aust. On ledges. (Moser). Herb. Crevices of rocks, Tobique. (Hay).
64. TETRAPHIS pellucida, Hedw. On rotten stumps, common. Herb.
65. TAYLORII tenuis, Schimp. Barrens. (Moser). Herb.
66. TETRAPLODON angustatus, Bruch and Schimp. Madawaska (Brittain). Near Lily Lake, St. John (Hay).
67. T. mnioides, Bruch and Schimp. Highland Park, St. John, and Tobique. (Hay).
68. SPLACHNUM ampullaceum, Linn. On earth, Fredericton Junction (F's C.) Swamps, Bocabec and St. John (Hay). On earth (Moser). Herb.
69. S. rubrum, Linn. (F's C.) Lancaster (Hay). Hunter's Home, Queens Co. (Moser). Herb.
70. BARTRAMIA œderiana, Swartz. On rocks, Tete-a-Gouche Falls, Gloucester (F's C.) Near St. John (Hay).
71. B. pomiformis, Hedw. On ledges and banks, along streams, common. Herb.
72. PHILONOTIS fontana, Brid. About springs, common. Herb.
73. P. glabriuscula, Kindberg. (New species).

"Tufts radiculose below, 4 cm high. Stem slender. Leaves small, green, distant, spreading and straight when moist, twisted when dry, indistinctly decurrent, short ovate lanceolate, short acuminate, acute, slightly papillose, pellucid. plane at the margins, not plicate, minutely serrulate, principally above. Cells oblong, hexagonal, the lower narrower, less chlorophillose. Costa subcurrent, Habit of Webera albicans." (From "Canadian Musci.")

It varies to a delicate floating form, as also does P. fontana.

Spring, in Owl Bridge Gully, Q. Co., but principally across the Washademoak (south) in a spring in the woods east of Martin's farm; also at Hunter's Home and at Elmwood, Kings Co. Always barren (Moser). Herb.

74. AMBLYODON dealbatus, Beauv. Brooklets. Herb. "One summer there was abundance in a spring brooklet, the next summer there was not any, nor since." (Moser).
75. LEPTOBRYUM pyriforme, Schimp. On recently burnt soil, common. Herb.
76. WEBERA acuminata, Schimp. On rocks, also in Restigouche Co. (F's C.)
77. W. nutans, Hedw. Common. Herb.

78. W. Lescuriana, Lesq. and James. On the ground by roadsides. (F's C.) Sandy bank, Tay, Glen Margaret, Halifax Co., N. S. (Moser). Herb.
79. W. cruda, Schimp. (F's C.) Crevices of rocks, Hunter's Home, Q. Co. (Moser). Herb.
80. W. albicans, Schimp. On banks. (Moser). Herb.
81. Bryum pendulum, Schimp. On rotten wood. (F's C.)
82. B. uliginosum, Bruch and Schimp. Tay. (Moser). Herb.
83. B. intermedium, Brid. Rocky places. (Moser). Herb.
84. B. cirrhatum, Hoppe and Hornsch. (Moser). Herb.
85. B. bemum, Schreb. Borders of swamps. (F's C.) Wet woods, Forks. Boggy places, Elmwood, Kings Co. (Moser). Herb.
86. B. pallescens, Schleich. On earth. (Moser). Herb.
87. B. subrotundum, Brid. (Moser). Herb.
88. B. alpinum, Linn. Hunter's Home. (Moser). Herb.
89. B. caespiticium, Linn. On dry ground. (F's C.) Common at Canaan, Q. Co. (Moser). Herb.
90. B. pseudo-triquetrum, Schwaegr. Wet rocks. (F's C.) On earth. (Moser). Herb.
91. B. roseum, Schreb. Shady woods. (F's C.)
92. B. Ontarioense. (Moser). Herb.
93. Mnium medium, Bruch and Schimp. Deep shady ravines. (F's C.)
94. M. cuspidatum, Neck. Common. Herb.
95. M. Drummondii, Bruch and Schimp. In large patches on the ground in shady places. (F's C.) Tay. (Moser). Herb.
96. M. affine, Bland. Damp shaded bank of brook. (F's C.); also at Fredericton. Tay. (Moser). Herb. Common St. John Co. (Hay).
97. M. hornum, Linn. St. John Co. (west) abundant. (Moser). Herb.
98. M. orthorrhyncum, Bruch and Schimp. Grand Falls, Nepisiquit. (F's C.) (Moser). Herb.
99. M. pseudo-lycopodioides. In damp shaded ravines (F's C.); also at Fredericton. (Moser). Herb.
100. M. spinulosum, Bruch and Schimp. Damp shaded places. (F's C.) (Moser). Herb.
101. M. stellare, Reichard. Carleton. (F's C.) (Moser.
102. M. punctatum. Damp shady ravines (F's C.); also at Fredericton. Swamps, Tobique River, (Hay). (Moser). Herb.
103. Aulocomnium palustre, Schwaegr. Common. Herb.
104. Atrichum undulatum, Beauv. On the ground. (F's C.) (Moser). Herb.
105. A. angustatum, Bruch and Schimp. On the ground. (F's C.) (Moser). Herb.
106. Pogonatum brevicaule, Beauv. On clayey soil. (F's C.) (Moser). Herb.
107. P. urnigerum, Drumm. Dry turf on a ledge. (Moser). Herb.
108. P. alpinum, Roehl. Wet rocks, Tobique, (Hay). (Moser). Herb.
109. Polytrichum piliferum, Schreb. Gravelly knolls (F's C). Dry ground on rocks, Forks Stream. (Moser). Herb.
110. P. juniperinum, Willd. Gravelly knolls, common. Herb.
111. P. strictum, Banks. In swamps. (Moser). Herb.

112. P. commune, Linn. Common on wet barren ground. (Moser). Herb.
113. FONTINALIS antipyretica, Linn. In brooks, common.
Var. gigantea, Sulliv. Shallow streams, Tobique, (Hay). (Moser). Herb.
114. F. Dalecarlica, Bruch and Schimp. In brooks. (Moser). Herb.
115. DICHELYMA capillaceum, Bruch and Schimp. Grand Lake and Newcastle (F's C.) On sticks and roots skirting swamps, Forks. (Moser). Herb.
116. D. palliscens, Bruch and Schimp. On roots of alders, Hunter's Home. (Moser). Herb.
117. D. obtusulum. Fredericton. (F's C.)
118. NECKERA pennata, Hedw. On trees, common. Herb.
119. HOMALIA Macounii, C. M. and Kindberg. (New species).
H. trichomanoides, Lesq. and James. "Mosses of North America." (Drummond, Waghorn and Macoun). On rocks, Forks Stream and Tay, York Co. (Moser). Herb.
120. LEUCODON sciuroides, Schwaegr. On bark of trees, common. Herb.
121. PTERIGINANDRUM filiforme, Hedw. (F's C.)
122. THELIA compacta. On trees. (Moser). Herb.
123. MYURELLA julacea, Bruch and Schimp. On damp rocks. (Moser). Herb.
124. M. Careyana, Sulliv. On rocks, St. John. (F's C.) Crevices of rocks, Queens Co. (Moser). Herb.
125. LESKEA polycarpa, Ehrh. On trunks of trees, Nashwaaksis, York Co. (Moser). Tobique, (Hay). Herb.
126. L. nervosa, Sulliv. On trees, Fredericton, (F's C.) Tay, (Moser). Herb.
127. L. denticulata, Sulliv. On roots of trees. (Moser). Herb.
128. ANOMODON rostratus, Schimp. Fredericton, (F's C.) On the sides of wet cliffs and on wet roots. (Moser). Herb.
129. A. attenuatus, Hueben. Bases of old trees and stumps. (Moser). Herb.
130. A. obtusifolius, Bruch and Schimp. Old stumps, Tay. (Moser). Herb.
131. A. veticulosus, Hook. and Tayl. Ledge of rocks, Butternut Ridge, Kings Co. (Moser). Herb.
132. PLATYGIRIUM repens. Bruch and Schimp. On dead wood. (Moser). Herb.
133. PYLASIA polyantha, Bruch and Schimp. On the bases of trees, common. Herb.
134. P. intricata, Bruch and Schimp. On trees, Fredericton, (F's C.) Tobique, (Hay).
135. P. velutina. On trees F's C.) Tay. (Moser). Herb.
136. ENTODON cladorrhizans. On logs, Tay. (Moser). Herb.
137. E. brevisetum. On old logs and rocks. (Moser). Herb.
138. CLIMACIUM dendroides, Web. and Mohr. On the ground in dense shade, Molus River, Kent Co. (F's C.)
139. C. Americanum, Brid. Wet places (F's C.) (Moser). Herb.
140. HETEROCLADIUM dimorphum, Bruch and Schimp. On a wet bank, Tay, York Co. Scarce. (Moser.) Herb.

141. H. frullaniopsis, C. M. and Kindberg. (New species). Base of poplar trees, Hunter's Home, Queen's Co. (Moser). Herb.

This species differs very much from allied species principally in the uniform leaves, the absence of paraphyllia and the not cordate leaf base. Dioecious.

142. THUIDIUM scitum, Aust. On trees, Fredericton. (F's C.)
143. T. minutulum, Bruch and Schimp. (F's C.)
144. T. recognitum, Lindb. (Moser). Herb.
145. T. gracile, Bruch and Schimp. (Moser). Herb.
146. T. delicatulum, Bruch and Schimp. Common. (Moser). Herb.
147. T. abietinum, Bruch and Schimp. On rocks and ground, Restigouche. (F's C.)
148. T. Blandonii, Bruch and Schimp. Bogs. (Moser). Herb.
149. CAMPTOTHECIUM nitens. Schimp. Swamp, Hunter's Home. Not common. (Moser). Herb.
150. BRACHYTHECIUM laetum, Bruch and Schimp. On rocks, ground and roots of trees, common. (F's C.) (Moser). Herb.
151. B. digastrum, C. M. and Kindb. (New species). On rocks, Ottawa, Ont., Oct. 12th, 1889 (Macoun). On rocks, Canaan Forks, Queens Co., 1889 (Moser).
152. B. acuminatum. Bases of trees. (Moser). Herb.
153. B. salebrosum, Bruch and Schimp. On earth, common about the Tay. (F's C.) (Moser). Herb.
154. B. albicans, Bruch and Schimp. (F's C.)
155. B. harpidioides, C. M. and Kindb. (New species). On old logs in woods. Columbia River, May 6th, 1890. (Macoun). 1889. (Moser).
156. B. pseudo-collinum, Kindb. Queens Co. (New species). Under platform of a well. (Moser).
157. B. velutinum, Bruch and Schimp. (F's C.)
158. B. Starkii, Bruch and Schimp. (F's C.)
159. B. oedipodium. Under shade on light ground. (Moser.) Abundant. Herb.
160. B. curtum. On earth in woods. (Moser.)
161. B. reflexum, Bruch and Schimp. On rocks, Queens Co. (Moser.) Herb.
162. B. rutabulum, Bruch and Schimp. (F's C.)
163. B. leucoglaucum, C. M. and Kindb. (New species). On loose earth, Queens Co., and at Elmwood, Kings Co. September 10th, 1888. (Moser). Herb.

Intermediate between B. rutabulum and B. curtum.

164. B. mirabundum, C. M. and Kindb. (New species). On old logs in woods, Canaan and Elmwood. July, 1888. (Moser). Herb.
165. B. campestre, Bruch and Schimp. On the ground. (F's C.) On rocks and logs. (Moser). Herb.
166. B. rivulare, Bruch and Schimp. (F's C.) Also at Fredericton. On wet ground and stones in brooks. (Moser.) Herb.

Var. obtusifolium, Kindb. Also named Novæ Brunsviciæ. On wet rocks, Fredericton. (F's C.) Ontario and British Columbia. (Macoun). Near springs. (Moser). Herb.

167. B. populeum, Bruch and Schimp. (F's C.) On granite boulder in brook. (Moser). Herb.

168. B. plumosum, Bruch and Schimp. (F's C.) Also at Fredericton, Elmwood. (Moser). Herb.

169. SCLEROPODIUM illecebrum, Bruch and Schimp. On damp rocks. (Moser). Herb.

170. EURHYNCHIUM strigosum, Bruch and Schimp. (F's C.) (Moser). Herb.

171. E. piliferum, Bruch and Schimp. Rare. (Moser).

172. E. prælongum, Bruch and Schimp. Tay. (Moser). Herb.

173. E. Sullivantii. On rocks. (Moser). Herb.

174. E. hians. (Moser).

175. E. crassinerve, Schimp. Var. laxorite, Kindb. New var. On rocks in woods. (Moser).

Differs in the leaves being nearly entire or faintly denticulate above, shorter, acuminate, and the cells larger. Only male flowers found. Allied to E. colpophillum.

176. RAPHIDOSTEGIUM recurvans. Kent Co. (F's C.) Common. (Moser). Herb.

177. R. demissum. On stones, rare. (Moser). Herb.

178. R. cylindrocarpum. On decayed logs. (Moser).

179. R. Jamesii. (Moser).

180. RHYNCOSTEGIUM serrulatum. (Moser). On rotten wood. (F's C). Herb.

181. R. rusciforme, Bruch and Schimp. On rocks, St. John River (F's C). Tobique River. (Hay). (Moser). Herb.

182. PLAGIOTHECIUM pulchellum, Bruch and Schimp. On rotten wood, Nashwaaksis, and Canaan. (Moser.) Herb.

183. P. turfaceum, Lindb. Common. Herb.

184. P. Muehlenbeckii, Bruch and Schimp. On old logs. (F's C.) Tobique and Norton. (Hay.)

185. P. denticulatum, Bruch and Schimp. (F's C.) Highland Park, St. John. (Hay). Common. (Moser.) Herb.

186. P. sylvaticum, Bruch and Schimp. Fredericton. (F's C., and Moser.) Herb.

187. P. Sullivantiæ, Schimp. On earth, Elmwood and St. John. (Moser). Herb.

188. P. aciculari-pungens, C. M. and Kindb. (New species.) On earth, 1889. (Moser.)

This species is nearly allied to Plagiothecium sylvaticum, but the leaves are larger, the tufts more compact.

189. AMBLYSTEGIUM speirophillum, Kindb. (New species.) On face of wet stones, York Co. (Moser). Herb.

190. A. confervoides, Bruch and Schimp. On stones in woods. (Moser.) Herb.

191. A. serpens, Bruch and Schimp. (F's C.) (Moser.) Herb.

192. A. porphyrrhizum, ——. Fredericton. (F's C.) On damp earth. (Hay and Moser.) Herb.

193. A. varium, Hedw., Lindb. Near Fredericton. (F's C.) On roots of trees. (Moser). Herb.

194. A. orthocladon. (F's C.)

195. A. fluviatile, Bruch and Schimp. On rocks, St. John River. (F's C.) (Moser.) Herb.

196. A. adnatum. On stones in woods. (Moser). Herb.

197. A. compactum. On the bases of trees. (Moser.) Herb.

198. A. riparium, Bruch and Schimp. On stones in brooks, Molus River. (F's C.) Kennebecasis Island, (Hay). Tay, (Moser). Herb.

199. HYPNUM hispidulum, Brid. Bass River and Little Branch, Miramichi. (F's C.) On bases of trees. (Moser). Also at Elmwood. Herb.

200. H. Sommerfeltii. On old logs. (Moser). Salmon River, Kent Co. (F's C.) Herb.

201. H. chrysophillum, Brid. On logs, Tobique River. (Hay). (Moser). Herb.

202. H. unicostatum, C. M. and Kindb. (New species). (Moser). Near Ottawa, October 4th, 1890. (Macoun). Near Kingston, Ont., May 23rd, 1884. (Prof. Fowler).

203. H. polygamum, Wils. Base of trees. (Moser). Herb.

204. H. Kneiffii, Schimp. In swamps, Queens Co.. (Moser). Herb.

205. H. sendtneri, Schimp.. In bogs. (Moser). Herb.

206. H. fluitans, Linn. In bogs, Coldbrook. (Hay). Herb.

207. H. exannulatum, Guemb. In boggy places. (F's C). Queens Co. and Elmwood, Kings Co. Common. (Moser). Herb.

208. H. uncinatum, Hedw. Common. (F's C.) (Moser). Herb.

209. H. Moseri, Kindb. (New species).

Differing from H. uncinatum in the leaves not being striate, but sometimes recurved at the base; costa faint, often failing; differing from all the other Harpidia in the stem, being densely radiculate.

On the bases and trunks of poplar trees, Dec. 30th, 1889 (Moser). Newfoundland (Rev. A. Waghorne). Herb.

210. H. filicinum, Linn. Near springs, Tobique River. (Hay). Forks (Moser). Herb.

211. H. chloropterum, C. M. and Kindb. (New species).

Resembles H. Novae-Angliae in habit, but differs considerably in the distinctly papillose, looser and patent, wider areolate leaves and the monoecious inflorescence, and in other respects.

On rocks, New Harbour, Newfoundland. (Rev. A. Waghorne). Near a spring, Owl Bridge Gully, Forks, and on wet ground, in shade, at Elmwood, K. C. (Moser). Herb.

212. H. Novae-Angliae, Sulliv. and Lesq. In large patches, Bass River. (F's C.) (Moser.) Herb.

213. H. commutatum, Hedw. On earth in a swamp. (Moser). Herb.

214. H. crista-castrensis, Linn. On old logs. (Moser). Herb. Bass River. (F's C.) Tobique River (Hay).

215. H. molluscum, Hedw. On logs, Tobique. (Hay). (Moser.) Herb.

216. H. reptile, Michx. On stones and bases of trees, common. Herb.

217. H. pallescens, Beauv. Fredericton and Grand Lake. (F's C.) (Moser).

218. H. callichroum. (Moser). Herb.

219. H. fertile, Sendt. (F's C.) (Moser). Tobique. (Hay).

220. H. imponens, James. Old logs. (Moser). Herb.
221. H. subimponens, Lesq. Old logs. (Moser). Herb.
222. H. complexum, Lesq. and James. On rocks. (Moser). Herb.
223. H. Lindbergii, Mitt. (H. arcuatum, Lindb.) On rocks. (Moser.) Also at Elmwood. Herb.
224. H. Renauldii, Kindb. (New species). On damp earth in shade; abundant. (Moser). Herb. Reported by Macoun and Rev. A. Waghorne.
225. H. curvifolium, Muell. Common along wet banks and in brooks. (Fowler, Hay and Moser). Herb.
226. H. pratense, Koch. On earth. (Moser).
227. H. Haldanianum, Grev. On old logs, common. (F's C., and Moser). Herb.
228. H. nemorosum, Koch. On decayed wood. (Moser).
229. H. flaccum, C. M. and Kindb. (New species). On logs and rocks. (Moser). Owen Sound, Ont. (Macoun). Herb.
230. H. palustre, Hedw. On rocks in brooks. (Moser). Herb.
231. H. circutifolium, C. M. and Kindb. (H. molle, Lesq. and James). Nearly allied to H. dilatatum, Wils. On rocks in brooklet emptying into Tay. (Moser). Herb.
232. H. engyrium, Schimp. On stones. (F's C.)
233. H. ochraceum, Turn. On stones in brooks, Nashwaaksis and Canaan. (Moser). Kent County and Fredericton (F's C.) Herb.
234. H. stramineum, Dicks. Among sphagnum. (F's C.) Tay (Moser). Herb.
235. H. cordifolium, Drumm. In wet, sandy places; common. Herb.
236. H. giganteum, Schimp. Springs and swamps (Moser). Herb.
237. H. sarmentosum, Wahl. Bogs. (Moser). Herb.
238. H. cuspidatum, Linn. Shore of Washadamoak. (Moser). Herb.
239. H. Schreberi, Willd. Common everywhere. Herb.
240. H. splendens, Hedw. In dense mats on damp rocks, or on the ground but at Nashwaaksis, in the woods, it is gregarious. (F's C.) (Moser). (Hay). Herb.
241. H. umbratum, Ehrh. (F's C.) (Moser). Common by brooklets. Have not found it in fruit. Herb.
242. H. brevirostre, Ehrh. In dense mats on granite boulders in the shade; no fruit, Halifax Co., N. S. Herb. (Moser).
243. H. squarrosum, Linn. In grassy, shady slopes. Have not found it in fruit. (Moser). Herb.
244. H. triquetrum, Linn. Common. (Moser). (F's C.) Herb.
245. H. pyrenaicum, Spruu. (H. Oakesii, Lesq. and James). On old logs and stones. (Moser). Herb.

ARTICLE IV.

RECENT DISCOVERIES IN THE ST. JOHN GROUP, No. 2.

BY G. F. MATTHEW, D. SC., F. R. S. C.

(Read January 5, 1897.)

(See also Bull. IV., p. 97; Bull. V., p. 25; Bull. X., p. 34, x. and xi.; Bull. XI., p. 11; Bull. XIII., p. 94.)

Since the description was given in Bulletin X., page 34, of the genus Protolenus, and its place in the Cambrian succession, and of Trematobolus, in Bulletin XIII., p. 94, no record has been presented to the Society of the progress made in the study of the Acadian Cambrian faunas. It seems desirable, therefore, to add here a few words on this subject.

The Protolenus Fauna.—The chief work done of late in this direction has been the elaboration of the Protolenus Fauna*, which appeared in the Transactions of the New York Academy of Science (Vol. XIV., p. 101 to 153, Pl. 1 to 11, and Fig. 1).

Any fauna which can be found in the sediments of the earth's crust older than those which contain the Primordeal Fauna of Barrande is of interest to naturalists and geologists, because Barrande named this fauna as being the oldest, as he thought, except traces of worms that had existed on the earth. But beside the peculiar fossils of the Laurentian and other pre-Cambrian rocks, several faunas of greater antiquity have since been described by Linnarsson in Sweden, by Kjerulf in Norway, by Schmidt in Russia, and by Hicks in Wales; but these European faunas agree in having only a few species of trilobites. A fuller representation of pre-Primordeal trilobites is that discovered by C. D. Walcott in Newfoundland; but even this does not reach, in variety of trilobites, the number shown in the Protolenus Fauna. From this cause and others, a brighter light is thrown on various zoological problems by the facies of this fauna than by that of any of the others.

* This fauna is contained in Division 1, Band *b*, or the Zone of Protolenus (Bergeronia articephalus (formerly *Agraulos articephalus*). See Bull. X., p 12.

In studying the development of the Primordeal trilobites by means of their young, we find certain features in the latter which are lost in the adult. But among the trilobites of the more ancient Protolenus Fauna these features are to be found subsisting in the full-grown trilobite.

One of these features is a long, cylindrical glabella (or middle lobe of the head-shield). This in many of the larval trilobites is enlarged in front, and so we find it in the adult of the genera Micmacca and Ellipsocephalus of this fauna, showing how primitive these forms are. Many of the trilobites have cylindrical glabellas (Avalonia and Protolenus), which cylindrical shape is the second phase shown in the glabella of the larval trilobites. Moreover *none* of the trilobites of the Protolenus Fauna have contracted their glabellas to the short, conical form prevalent in the trilobites of the Primordeal Fauna (Ptychoparia, Conocephalites, Conocoryphe, Ctenocephalus, etc.)

Another feature in the trilobites of the Protolenus Fauna is the prevalence of a continuous eyelobe. The eyelobe is a protective ridge extending along a portion of the seam between the middle piece of the head-shield and the movable cheek. In many Cambrian trilobites this lobe is quite short, but in others, while it is short in the adult, it is longer in the larval stages; this is notably the case in Paradoxides, which in the earliest species, and in the young of all the species studied, has continuous eyelobes—that is, eyelobes extending to the posterior furrow of the head-shield. Now this character of a continuous eyelobe marks *all* the trilobites of the Protolenus Fauna in which this part of the headshield has been preserved.

A narrow, movable cheek is apt to be associated with a continuous eyelobe, and such movable cheek is the only kind so far found with the trilobites of the Protolenus Fauna; sometimes with, sometimes without a genal spine. Such a cheek exists in the early larval examples of Pytchoparia and allied genera of the Primordeal Fauna, but disappears in the adult, in which the area of the cheek is often quite wide, owing to the withdrawal of the eye from the margin of the headshield during growth.

A fourth primitive character of the trilobites of the Protolenus Fauna is the shortness of the pleuræ, or lateral extensions of the thoracic rings. This may be observed as a characteristic of many trilobites in the larval state, but disappears as the species comes to maturity. Ellipsocephalus and several Agrauli preserve this character in the adult condition, but in the majority of Primordeal trilobites

(*See page 36*).

SOME TYPES OF THE PROTOLENUS FAUNA.

BRACHIOPOD.

TREMATOBOLUS INSIGNIS.—*a.* Interior of the ventral valve. *b.* Interior of the dorsal valve. *c.* Dorsal valve seen from behind. *d.* Inside of beak of ventral valve. *Notation of the muscles, etc.* *p. a.* Posterior adductor. *a. d.* Adjuster muscles. *l. m.* Lateral muscles. *a. p.* Anterior depression. *c. p.* Cardinal pit. *c.* Cardinal process. *s.* Hinge socket. *t.* Dentiform process of the ventral valve. *f.* Foramen. From Assize 2, Band *b*, Div. 1, St. John Group at Hanford Brook, St. John County, N. B.

TRILOBITES.

PROTOLENUS ELEGANS, W. D. Matthew (second group on left side).—The upper figure represents the head shield. The detached piece to the right is the movable cheek. The middle figure shows a joint of the thorax. The third figure is a side view of the head-shield.

PROTOLENUS PARADOXOIDES (second group on right side).—This represents the head-shield, with the movable cheek to the right, a little separated from the middle piece.

N. B.—All the above are figured of the natural size.

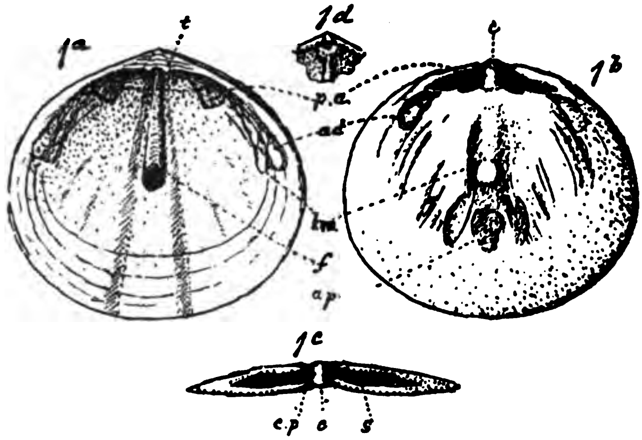
PROTOLENUS ARTICEPHALUS (third group on left side).—The upper figure represents the middle piece of the head-shield. The second figure shows this part viewed from the side.

ELLIPSOCEPHALUS GALEATUS (third group on right side).—The upper figure represents the head-shield, with the movable cheek somewhat separated. The second figure is a side view of the same. The third figure represents a segment of the thorax. The fourth figure is a side view of the middle piece of the head-shield, of the variety or mutation AGRAULOIDES.

N. B.—All the figures of the third groups, right and left sides, are magnified two diameters.

OLENUS ZOPPII, Menigh.—A complete trilobite, supposed to be a later derivation from the same stock as Protolenus. From the Cambrian of Sardinia, Italy. Introduced to show an entirė trilobite of this family, and the relation of the different parts of the test of a trilobite to each other. The other figures of trilobites here given show parts of the test only.

The following genera compose the Protolenus Fauna: FORAMINIFERA, Orbulina 4 sp., Globigerina 4 sp. SPONGIDA, Monadites, Protospongia, Astrocladia? BRACHIOPODA, Lingulella 2 sp., Lingulella? 2 sp., Obolus, Botsfordia, Trematobolus, Protosiphon, Obolella, Linnarssonia, Acrotreta 2 sp., Acrothele. MOLLUSCA, Hyolithellus? Coleoides? Orthotheca, Hyolithes 5 sp., Diplotheca 2 sp, Pelagiella, Volborthella. OSTRACODA, Hipponicharion 3 sp., Beyrichona 6 sp., Aparchites 2 sp., Primitia 4 sp., Schmidtella, Leperditia 4 sp., Beyrichia. PHYLLOPODA, Lepiditta. TRILOBITA, Protagraulos, Ellipsocephalus 3 sp., Micmacca 4 sp., Avalonia, Protolenus 2 sp., subgen. Bergeronia 2 sp.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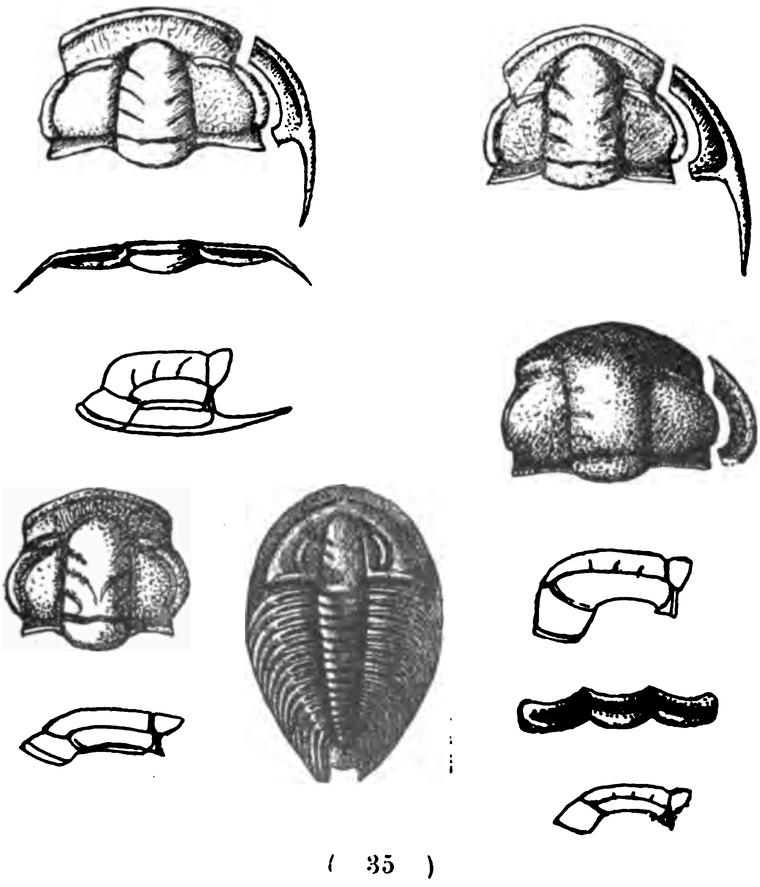


the pleuræ become extended in length when the animal is fully grown. Many of the trilobites of the Protolenus Fauna have short pleuræ, and none have been found to possess the prolonged pleuræ which mark many species of the Paradoxides and Olenus Zones (Primordeal).

The development of a pygidium, or tail-piece of many joints, is common in many trilobites of the Primordeal Fauna, and is still more common in the Ordovician system above it. This part of the body-covering is built of segments that were added gradually in the different moults as the individual trilobite progressed toward maturity. A pygidium of a few joints is therefore a primitive character, and the entire subordination of this part to the headshield is a mark of simplicity of structure; it is so throughout the Cambrian system*, but in the next geological system (Ordovician) we sometimes find the pygidia preserved in greater numbers and perfection than the head-shields (*e. g.*, Asaphus). As a contrast to this, it may be said that while there are thirteen species of trilobites in the Protolenus Fauna, of which a hundred or more of heads have been found, only one pygidium has been recognized. The pygidia of many of these species must, then, be small and insignificant.

The primitive standing of the trilobites of this fauna is shown by the following characteristics:

1. The long, cylindrical glabella.
2. The continuous eyelobe.
3. The narrow movable cheek.
4. The short pleura.
5. The small pygidium.

This fauna is remarkable for the variety and size of its ostracods, and they differentiate the fauna into two sections — the lower in Assize 1 marked by the presence of the genus Hipponicharion, the upper in Assizes 2-4 marked by that of Beyrichona. These ostracods are of comparatively large size, and, with other genera of this order, there are a score of species. We seem to find this section of the crustaceans beginning to take the place of the trilobites in those oldest Cambrian beds, and it may be the dominant order in older deposits.

In this fauna we find ourselves among a very primitive assemblage of Brachiopods, for among them are forms which it is difficult to assign

* The two genera, Microdiscus and Agnostus, may seem not to bear out this principle, but it is to be remembered that these are abnormal genera, for in the former the joints of the thorax may be from two to four, while in the latter they are strictly limited to two; hence the pygidium enlarged, by additional somites, as a counterpoise to the enlarging headshield. This provision enabled the animal to fold itself together and thus protect its soft under parts.

to any known genus; many are small, some are minute, and the larger forms belong to the Obolidæ and Siphonotretidæ. One of the latter is remarkable as being of the inarticulate order, yet having a distinct articulation at the hinge (Trematobolus). Another is notable in beginning life as one genus (Schizambon) and closing it as another (Siphonotreta), this being shown by the larval stages through which it passed.

A remarkable occurrence in this fauna is that of Foramenifera, of which several genera are present. The most notable are Orbulina and Globigerina, which at present are inhabitants of the open sea, on whose bottom they have left in modern times deposits of vast extent and thickness. Foramenifera abound in some of the Carboniferous deposits, but they have not been reported, so far as I know, from older geological systems; they will, however, probably be found in the intermediate deposits.

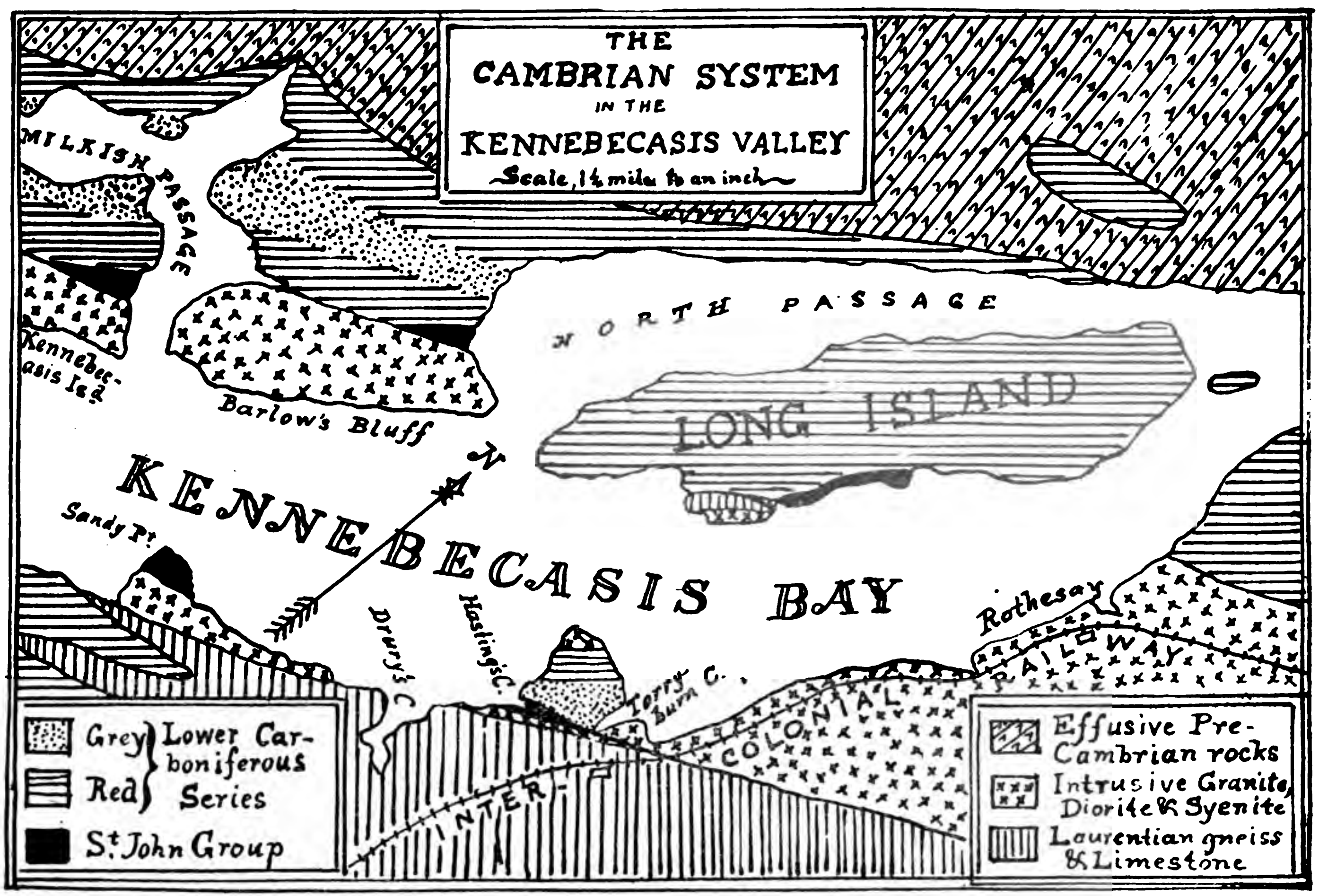
From the preceding remarks it will be seen that the exploitation of the Protolenus Fauna has resulted in a useful addition to the knowledge of early Cambrian geology.

The Geological Map of part of Kennebecasis Valley. (See next page). —This map, originally prepared to show the distribution of the Cambrian rocks of Kennebecasis valley, is useful also to exhibit other points in the geology of this interesting basin. The index to the formations is divided and placed in the lower corners, that part to the right shows the Pre-Cambrian rocks, that to the left the Cambrian and later terranes.

The foundation of the whole geological structure is the portion indicated by vertical bars. These are very ancient sedimentary masses classed with the Laurentian system of Canada. These old stratified rocks have been broken through by igneous intrusions (quartz-diorites, etc.,) of great age, which form a belt across the map, interrupted at points by the waters of Kennebecasis Bay.

Next in age come the great mass of igneous rocks of effusive or volcanic origin which form the principal part of the parish of Kingston, these occupy the upper side of the map. A parallel arrangement may be seen to hold for these three belts; this is due to the presence of ancient and profound faults or breaks in the earth's crust of very ancient date that run in an E. N. E. direction; along these fault lines the rocks have moved up and down more or less during the ages.

Black areas are those occupied by Cambrian rocks which now form


THE CAMBRIAN SYSTEM IN THE KENNEBECASIS VALLEY
Scale, 1½ miles to an inch
MILKISH PASSAGE
Kennebecasis Isd.
Barlow's Bluff
NORTH PASSAGE
LONG ISLAND
N
KENNEBECASIS BAY
Sandy Pt.
Drury's C.
Hastings C.
Torryburn C.
Rothesay
INTER-COLONIAL RAILWAY
Grey
Red
Lower Carboniferous Series
St. John Group
Effusive Pre-Cambrian rocks
Intrusive Granite, Diorite & Syenite
Laurentian gneiss & Limestone

narrow strips or wedge-shaped belts of small extent, which it will be seen, are always closely connected with the older rocks.

Lastly, the Lower Carboniferous rocks form basins of sediments, filling in the hollows of the Cambrian and the older rocks and spreading in the valleys. They are the youngest rocks visible in this area, except the loose aggregations of Post-pleiocene gravel, sand and clay which are not represented in this map. The Lower Carboniferous shows two principal divisions—one reddish and of marine origin, the other of grey color and containing scanty remains of land plants rare in this part of the valley, but more abundant farther eastward. The relative antiquity of these two parts of the formation has not been determined. The grey beds are seen at Hasting's Cove, on the south side of Kennebecasis valley, and in Milkish passage on the north side.

A great accumulation of boulder beds in the red division of this system is well exposed on Long Island, where it comes out on the river at the "Minister's" Face, a bold bluff extending from the outcrop of Cambrian rocks half-way to the eastern end of the island.

The Cambrian Rocks of the Kennebecasis Valley.—It will be remembered that in the annual report of the Society for 1897 allusion was made to work carried on on the Cambrian rocks of the Kennebecasis valley. We are now able to present some of the results of this work.

Sedimentation.—The sedimentation of the Cambrian in this valley was found to show important differences from that of the valleys to the north and south.

All through the Etcheminian period, which preceded the true Cambrian, this valley, with the surrounding territory north, south and west, was elevated above the sea, and was apparently an island having recently ejected volcanic rocks to the north-west and south-east of the present Cambrian valleys. This island and the volcanic ridges furnished sediment to the Etcheminian sea.

When the Cambrian time arrived changes of level in the land took place, so that while the Kennebecasis valley sank beneath the sea, the ridges on either side of it, consisting, on one side of volcanic rocks, and on the other of old Laurentian sedimentaries, remained above the sea. Thus was the Cambrian sea in this district divided into three areas of deposition, which to some extent were independent of each other, but not so far as to make any very material difference in the faunas.

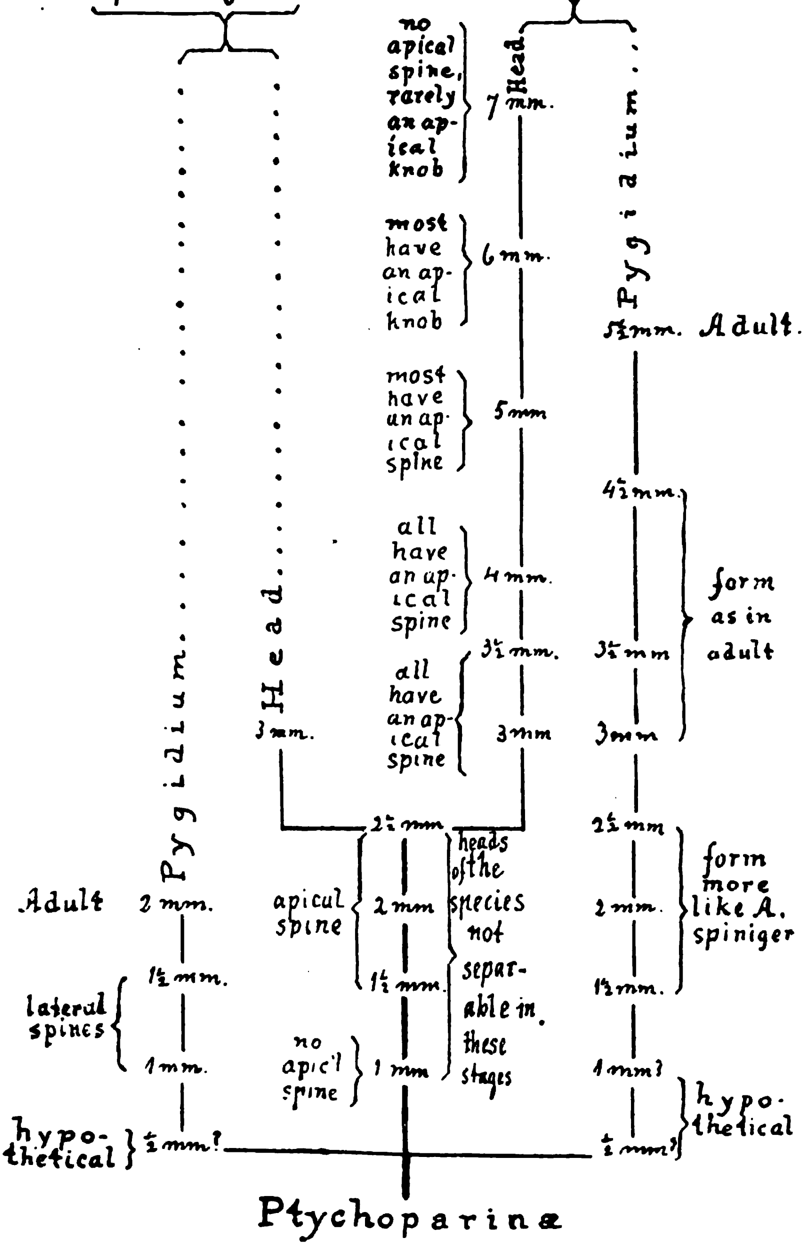
It is evident that the deposits in the middle basin (Kennebecasis valley) were much thinner than those of the southern (St. John) basin. This is shown by the small narrow strips of sediments of which the Cambrian here is composed, and by the absence of the upper division (Bretonian), which, being of fine soft shale, would be easily removed by denudation. The middle division (Johannian), which in the southern basin shows a thickness of 1,000 feet, is here so reduced as to show only a tithe of this thickness. The Paradoxides beds, though not well exposed, also seem much thinner than in the southern basin, and only the Protolenus beds, by their volume and texture, fully bear out the aspect of their counterpart in the southern basin.

It would appear, then, that while a great part of the Cambrian series is present in this valley, it is very much reduced in thickness; from this it may be inferred that the floor of the Cambrian sea was sinking in the area of the southern basin much more rapidly than in the middle basin, and for most of the time was being filled up with sedimentary deposits as fast as it sank.

Faunas.—An interesting discovery in the Kennebecasis valley was that of the fauna of Hasting's Cove, which is a sub-fauna of the Paradoxides beds. Hitherto we had not found in the Acadian Cambrian rocks anything to correspond to the Upper Paradoxides beds of Sweden, the sub-faunas found in the southern (St. John) basin being such as are paralleled by the Lower Paradoxides beds of that country. At Hasting's Cove, however, we came across some genera not before found in this region, and which recalled the facies of the Swedish Upper Paradoxides beds, these were Anomocare and Dolichometopus; and associated with them was the easily recognized genus Dorypyge, found in the Middle Cambrian of western America and of China. By this sub-fauna we can link the upper part of our Paradoxides beds with the corresponding rocks in Sweden, West America and China.

Another interesting discovery made in this valley was finding of a type of trilobite in company with *Agnostus pisiformis*, L., which showed peculiar phases of development. In this type were contained two species which, so far as the headshields are concerned, could not in the earliest stages be distinguished from each other. They first become separable by their pygidia, which in one species takes the form of Olenus and in the other that of Anomocare. It would thus appear that from the one phylum or stem-form two genera were developed. *(See the opposite page.)*

Development of *Acantholenus spiniger* & *Anomocare stenotoides*



The distinction of the headshields of the two species come at a later period of growth. Both, in the younger stages (though not in the youngest) have an apical spine on the margin of the headshield; this spine continues on the headshield of the Oleniod form, whose growth is arrested, so that it never reaches the size of the Anomocaroid form. In this latter the apical spine is gradually absorbed, so that in the final moult there is no trace of a spine in the front of the shield.

We see from this example how not only two species, but two genera, may be developed from the same rootstock. That is, the differentiation may produce two separate genera direct from the phylum, without the indirect method of producing separate species before the generic characters appear.

To make this instance of development more easily understood the diagram on the preceding page has been prepared, showing the branching of the trilobite *Acantholenus spiniger* from the stock which eventuated in *Anomocare stenotoides*. From this diagram it will be seen that the divergence occurred in very small heads, for even the caudal shield, 1 mm. long, of the former species has all the rings of the adult, hence the differentiation must have occurred in a still earlier moult. We assume that this may have been the ½mm. size. But if so the companion species *A. stenotoides* must have had an equally small pygidium as a starting point; so the differentiation must have occurred as early as the 1 mm. moult (*i. e.*, when the head and caudal shield together were of this length).

But, as the diagram shows, the head-shields of the two species cannot be distinguished until they reach a size of 2½mm. Had we perfect tests, however, showing the head and caudal shields in connection, we should be able to distinguish the two trilobites by the pygidia when this part was no more than 1½mm. long, but failing this the separation of the head cannot be effected before the 2½mm. moult. In the very smallest size the spine at the front of the shield (apical spine) cannot be found, but immediately thereafter becomes a distinguishing feature, and continues so through all the earlier moults. But by degrees it becomes absorbed in *Anomocare stenotoides*, as the diagram shows, but in the other species it continues as a distinct ornament until the full size is attained, which, however, is much below that of the species last named.

As no other type of trilobites that can be confounded with them occurs with these, it is clear that we have here a case of development

from a common stock which at once pass to different genera, one somewhat closely like an Olenus, the other diverging from a Pychoparian ancestor into the resembling genus Anomocare.

Other points of less moment have been noted in reference to the Cambrian faunas of the Kennebecasis valley; thus two of the thirteen species of trilobites of the Protolenus Fauna were found in olive-grey sandstones in this valley, and two new Ostracods were also obtained from the same beds. A very interesting Brachiopod from these sandstones was that which is referred to on an earlier page as passing during its growth from the condition of a Schizambon to that of a Siphonotreta.

Though since their deposition the Cambrian beds of this valley have suffered great disturbance and enormous denudation, and what remains of them are now to a great extent covered by the lake-like expansion of the Kennebecasis River, or concealed by sediments of Lower Carboniferous age, enough remains exposed to throw considerable light on their sedimentation and palæontology.

Upturnings and Dislocations of the Cambrian Beds.—The sharp folds into which the strata of the St. John basin were thrown have been described in Volume VIII of the Transactions of the Royal Society of Canada, pages 125 to 128, and displacements along faults of a high hade, of hundreds of feet. Horizontal displacement has also been shown by the result of well borings in the city of St. John and its neighborhood; the most remarkable are those that have come to light through borings in the upper (Bretonian) division. At Jones' Brewery on Union Street, a boring was put down to a depth of 385 feet, in what appeared to be a deep narrow trough of black shales, having an overturned dip of about 70 degrees. Theoretically, this bore should have been continuously in the black shales of this division, but at the depth of 317 feet the flag-stones of Division 2 were struck; these flags at the surface are about 300 feet to the N. W., hence there would appear to be a horizontal overthrust of the black slates on the flagstones to the extent of about 280 feet.

Similarly on the eastern side of Courtney Bay at the Almshouse, hard grey flags were encountered in a well sunk in the black slates at a depth of 700 feet and penetrated for 55 feet. Here the dip of the beds is about the same as in the city and the grey flags of Division 2 (Johannian) appear at the surface about 500 feet to the N. N. W.; hence there would appear to be an overthrust here of about 460 feet.

A force operating from the same direction as that which produces these old conditions of overthrust strata, is in operation on a milder scale at the present day, for by reference to No. 12 of this Bulletin, page 34, it will be seen that since the Glacial Epoch there has been dislocation of the strata of the St. John Group whose phenomena show thrusting from a S. E. direction. The old displacements, however, are on a gigantic scale compared with these.

ARTICLE V.

NOTES ON THE NATURAL HISTORY AND PHYSIOGRAPHY OF NEW BRUNSWICK.

BY W. F. GANONG.

4.—ON THE COLOR OF THE WATER IN NEW BRUNSWICK RIVERS.

Read March 2nd, 1897; re-written April, 1898.

New Brunswick is a land of splendid rivers. I have looked on the maps in vain for an equal extent of country elsewhere which can show so fine a series. For it might the words have been written : "A good land, a land of brooks of water, of fountains and depths that spring out of valleys and hills."

Everyone who has been much with rivers must have felt that they possess distinct characters or individualities. This character is a subtle aggregate, but a leading physical component of it is the purity and color of the water. The characters of our rivers I shall try elsewhere to express; I ask the Society now to consider the physical problem involved in their colors.

It is possible to find in the province every gradation between the sluggish, heavily sedimented, almost black streams of the peaty districts of Kent, Gloucester, and parts of Charlotte, and the rippling, limpid streams of the central and northern watershed. The causes of the color and opaqueness of the former are plain enough; they leach out the dark coloring matters of swamp and bog, together with much of the flocculent organic matter. But the clear northern rivers, when low in their stony beds, carry little sediment, and that not organic; but they show curious differences in color, for some of them are green and others are brown. In thus speaking of color, I do not refer to glint from their surfaces, nor the hue in rapids and waterfalls, but to that which one sees at low water, when he looks through a still surface, nearly vertically, into a deep pool with gravel or boulder bottom. Seen thus, the Restigouche is light green, and the Metapedia light brown; and where these two come together, one may run a canoe for three hundred yards on a boundary so sharp that on the right all is clear

green and on the left all equally clear brown. One may see the same contrast where Green River enters the St. John, but with a result less striking, for the greater river, though brown, is less clear. Indeed, the St. John water is of mixed color and texture—one might call it a golden brown—as would be expected from its receiving so great a mixture of streams. Another striking contrast of color is to be seen in the two branches of Charlo River. Where they cross the highway road, a quarter of a mile apart, the western is clear green, the eastern clear brown. The upper branches of the Restigouche are green; Nepisiguit is, I believe, brown; but I have no exact information as to the color of Tobique, and the many other clear rivers which abound in all the northern wilderness from Temiscouata and the St. John eastward. A Blue River empties into St. Francis, but I know not whether the name describes the water; and Blue Lakes are mentioned near the Cascapedia in the Geological Survey Reports (1881, D., p. 20), though the color is not in the water, but by reflection from the blue clay bottom. Blue water lakes occur, however, in Europe,* though green is much more common in clear lakes, both there and in this country.

The explanation of the difference between the green and brown colors is no doubt this: the physical composition of the purest river water is such that when white light enters and is reflected back through it, the green rays are absorbed least, and hence preponderate in the light which comes to the eye. The clear, brown rivers, on the other hand, though possessing green water as a basis, have added to it a brown liquid (not sedimentary) coloring matter, leached out from swampy places. What we know of the Restigouche and Metapedia is consistent with this, for the former has hardly any, if any, swampy area upon it, while the latter has at least some swamp around Metapedia Lake (Johnston, Notes on North America, I, 387). I have no such data for the two branches of Charlo River.

The subject has been carefully studied in Europe, and an important memoir on the subject has recently appeared.† It will aid to the solution of the problem if members of the Society will make exact observations upon the color of the water in our clear rivers, particularly giving attention to the character of the country through which they flow.

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* The deep blue color of the Lake of Geneva differs from that of the other Swiss lakes, which are all more or less of a greenish hue . . . the cause of the phenomenon has never been actually ascertained —Baedeker's Switzerland, 15th Ed., p. 22?.

† La Couleur des Eaux. Par Ad. Kemna. Bull. de la Soc. Belge de Geologie. X, 211.

5.—On the Heights of New Brunswick Hills.

Read April 6th, 1897; re-written April, 1898.

In the summer of 1896, I climbed two of the best-known and most accessible of the higher hills of the province—Squaw Cap in Restigouche, and Mount Pleasant in Charlotte. Later I sought information about their heights, but found, with surprise, that for neither was it accurately known; and later inquiry showed that this is true as to the heights of most New Brunswick hills. Indeed, nobody knows positively where the highest point in New Brunswick lies, much less how high it is.

It is generally stated that the highest point in the province is Big Bald Mountain, at the head of the Lower South Branch of Nepisiguit; but this, if not an error, is at least not proven. It rests solely on the authority of the Geological Survey map, which marks that mountain as 2,700 feet, the greatest height marked anywhere in the province. But this height appears to be a compiler's or copyist's mistake, for Dr. R. W. Ells, in his Geological Report (for 1881, D, 35) describing that region, estimates Bald Mountain at 2,500 feet—not 2,700—and he has recently had the kindness to write me that his estimate really was as given in his report, and that he does not know how the greater height came to be placed on the map. No other officer of the Geological Survey has been there, nor are measurements by anyone else known. He says, however, that he thinks Bald Mountain "the highest land in Northern New Brunswick—at least as far as I have travelled." The Geological map marks in that region "Peaks rising to 2,600 or 2,700 feet," which, of course, is so stated to include the height given to Bald Mountain. We must, therefore, consider that it is far from settled whether or not Bald Mountain is the highest in New Brunswick. If this measurement of 2,500 feet by Dr. Ells is correct, there is another higher peak in the province, namely, Bald Mountain, beside Nictor Lake, which is given on the Geological map as 2,537. This must therefore stand as, for the present, our greatest known height. It is not likely that any point in the province will reach 2,800 feet. Who will be the first to demonstrate the highest point in New Brunswick?

It will be of interest to note some heights elsewhere, for comparison. The highest in the world is Mount Everest, 29,000 feet; in Europe, Mount Blanc, 15,730 feet; in England, Scawfell, 3,208; in Wales, Wyddva, 3,571; in British America, St. Elias, 18,086; in the United States, Blanca Peak, 14,463; in New Hampshire, Washington, 6,290;

in Maine, Katahdin, 5,248; in Nova Scotia, the Cobequids, about 1,100. New Brunswick heights are therefore not great.

Our knowledge of New Brunswick heights above sea level is based upon the following data :

(1) Levels determined by canal, railroad, and waterworks surveys. These are many and valuable, but scattered, and not easily accessible, and he who would collect, and reduce them to a single datum, would do great service to our physiography.

(2) The line of levels run along the St. John from high tide at Chapel Bar, above Fredericton, to Grand Falls, by Robert Foulis, for the New Brunswick government, in 1826. They are recorded on a map in the Crown Land Office. It has been pointed out by Hind (Preliminary Report, 30) that Foulis' figures are too low, which Mr. Shewen tells me is confirmed by the railroad levels.

(3) Barometric and spirit-level observations made in connection with the Boundary disputes. One of these was a series across the province from Grand Falls to Bay Chaleur, made by the Boundary Commissioners in 1839. The full account of them is given in "Correspondence relating to the North American boundary," British Blue Book, 1840. A central station, whose height was determined from Foulis' levels, was established at Grand Falls, where the central observations for weather were made, and by mercurial barometers many heights along the Tobique, Nepisiguit, and Jacquet rivers were carefully determined. As Foulis' figures were used for the datum, all heights in this series are too low. These, with some others, are given in a list by Hind in his report on the geology of N. B., 1865, pp. 23-24, and many others from railway surveys and other sources are contained in the same work. Along the north line from the source of the St. Croix two lines have been run — one with barometer, by Bouchette, about 1817 (much too high), and another with spirit-level, by Graham, in 1840-41, published in a document of the 3rd Session, 27th Congress.

(4) The measurements by the Admiralty Survey of heights along the coasts, recorded on their charts. I do not know how they were made, nor their base level, but without doubt they were taken with care.

(5) The determinations with the aneroid barometer made by the officers of the Geological Survey of Canada, particularly by Robert Chalmers. These are all recorded on the official maps, and are frequently referred to in the various geological reports. They include lake surfaces, as well as hills. The controls for weather changes were obtained from the nearest meteorological stations in the province. Like all aneroid observations made by a single instrument in the field, the results can be regarded as only approximate. The base level is, on some maps, high tide; on others, mean tide.

(6) Aneroid and theodolite observations made by surveyors and others for their private satisfaction. William Murdoch, C.E., of St. John, has made more numerous measurements than any other that I know of, and he has kindly sent me a list of these. A few made by myself are recorded in a later note of this series (No. 13).

Most of our greater heights are of hills composed of very hard, intrusive rocks, the only kinds which have been able to withstand the long erosion which New Brunswick has suffered, and the awful battering which it received in the glacial period. They are either of granite, as in the higher Bald Mountain group, the Cow Mountains, Bald Mountain (Queens), Mount Pleasant, etc., or else of trap (Dolerite and Diorite), as in Squaw Cap,* the Blue Mountains, Moose Mountain, etc. The trap mountains are more abrupt and isolated than those of granite, both because they are intruded in smaller masses, and also, perhaps, because they are newer and less eroded, as well as harder. New Brunswick owes most of its bold and beautiful scenery to these intrusive rocks; and flat and tame indeed would much of its surface be were it not for them. Some heights occur in the hard pre-Cambrian rocks, as in Bald Mountain, and others near Nictor, and those along the Shepody Road in Kings and St. John. Some appear to be in much softer rocks, as Shepody Mountain, Green River Mountain, etc., though none of these are of great height. Possibly some of them are protected by local caps of trap, as in Chamcook.

The heights of New Brunswick will not be completely nor accurately known until a unified topographical survey of the entire province has been made; and this, because of its great expense, will be long in coming. In the meantime, there is here offered, to those of us who enjoy the pleasures of the chase, the opportunity to pursue, to our complete content, that most elusive and alluring of all great game, new, hard facts—in this case all the more charming since they must be sought through the hardships of the northern wilderness. The determination of our principal heights is a fine problem for young New Brunswickers.†

The heights recorded for the province have been taken above various datum lines. A single datum was wanting, but this has recently been established, by the calculation of mean tide level at St. John, by Mr. E. T. P. Shewen,‡ and no doubt future measurements will all be referred to it.

* The Geological Survey map colors it as composed of Upper Silurian rocks, but I found it to be made of the same intrusive, igneous rocks as compose Sugar Loaf and the other heights in that vicinity, and the red color on the map should be extended southwest to include them. Probably the surveyors did not visit them, and were deceived by the name Slate and by local descriptions. The rock breaks up into flat, somewhat slaty, pieces.

† Two observers working from the railroad levels with good barometers, one remaining at base level to check the other, could do much in summer excursions. Or a long line of levels could be carried across country by two parties with good aneroids—or, better, mercurial barometers—one going ahead a few miles to a new station, while the other remained as a check for weather; the latter then coming up, while the former was fixed as a check. This would establish a line of stations in which, supposing the instruments to work together, the only source of error would be the difference in weather pressure between the two stations, which would be the less the nearer the stations were together.

‡ See this Bulletin, later page.

A List of the Heights above Sea Level of the Best-known Hills of New Brunswick, with Authorities.

[A., Admiralty Charts; B., Boundary Commissioners; M., William Murdoch; G., myself (see note 13 of this series); G. F., Geological Survey, Maps of Formations; G. S., Geological Survey, Maps of Surface Geology.]

Bald Mountain, Nictor—2,537 (G. F.)
Bald Mountain, South Branch Nepisiguit—2,500 (R. W. Ells).
Squaw Cap—2,000 (G. S.—probably on authority of Hind).
Bald Head, Victoria—1,866 (G. F.)
Blue Mountain, Victoria—1,724 (G. F.)
Mars Hill, Maine—1,688 (B. C. and G. F.)
Moose Mountain—1,030 (G. F.)
Nashwaak Mountain—855 (G. F.)
Bald Mountain, Queens—1,120 (G. S.), 1,390 (M.), 1,462 (G.)
Shepody Mountain—1,050 (A.)
Sugar Loaf, Restigouche—950 (A.)
Mount Pleasant—1,200 (G.)
Chamoook—637, 627 (A.)
Ben Lomond—850 (M.)

For fuller lists, see Hind (already referred to) and Bailey, Report, 1886, G. 6.

6.—Dalhousie and Saint Andrews.—A Coincidence.

Read June 1st, 1897.

There is a curious likeness between the most northerly and most southerly towns of New Brunswick—Dalhousie and Saint Andrews. They stand where tidal rivers empty into salt bays, and circling about them are superb hill and sea views, in which Dalhousie has the advantage as to hills, and Saint Andrews as to water. Prominent in their landscapes are the Lower Carboniferous sandstones, which bear rich farms and wear into soft, red cliffs, contrasting beautifully with the blue of the sea. Both places are summer resorts, with big hotels, and the colors and chatter of the summer visitor in the streets. All of this is due to similar physiographic environment. Both are extremely neat, with tasteful, old-fashioned residences and gardens, which shows something in common in their people, perhaps a large proportion of thrifty Scotch. Both are regularly laid out, on ample scale, for both were expected to be—and for a time were—the principal towns of their counties. But the grass grows and quiet reigns in their streets, though with them both there is that air of self-respecting submission to the fall from better days which so often makes both places and people charming. For both are being surpassed by neighbors far less

attractive, but more happily situated for business, which in both cases happen to be about sixteen miles away at the head of navigation. One may trace yet other resemblances, some natural, some accidental. All of these things—physiography, history, people, accident—combine to produce in the two places an atmosphere not only remarkably alike, bnt extremely agreeable; and we may speak affectionately of the one as the Saint Andrews of the north, or of the other as the Dalhousie of the south, according to our point of view.

7.—On Halophytic Colonies in the Interior of New Brunswick.

Read Nov. 2nd, 1897; re-written April, 1898.

In the geographical distribution of plants no phenomena are of greater interest than the occurrence of colonies isolated far from their congeners in the midst of a different flora. The best known case of this, and one which will occur to everyone in this connection, is the presence of Arctic plants on high mountains even near the equator, and in bogs and other cold places. We have Arctic plants in New Brunswick, as Dr. Matthew* and Professor Fowler† have shown; but we have also another kind of isolated colony, which has not yet been described by our botanists—a colony of sea-shore plants at the Salt Springs near Sussex.

These springs—three or four in number—occur three miles east of Sussex, beside the highway road to Moncton. The brine was formerly, but is not now, boiled down for salt. They break out in the open fields and flow down to a fresh-water brook near by. On the sandy shore around the springs and along their outlets grow plants which give the place the appearance of a bit of the sea-shore. Several years ago I noticed these plants, and last August I visited the place, and collected the species listed below. The Phanerogams were identified for me by Mr. Walter Deane and Dr. B. L. Robinson of Cambridge, and the Algæ by Mr. F. L. Collins of Malden, to all of whom, for their valued aid, I tender my sincere thanks. They are listed about in the order of their abundance, and the notes were made on the spot.

1. *Salicornia herbacea, L.* The most abundant and characteristic plant; very red and succulent.
2. *Spergularia (Buda) salina*, Presl. On the sandy banks; very abundant.
3. *Spergularia salina*, var. *minor*, Rob. (?)
4. *Spergularia borealis*, Rob.

* See Canadian Naturalist, 1869. † See Trans. Royal Soc. Canada, V.

5. *Ranunculus Cymbalaria*, Pursh. On edge of the streams from the springs.
6. *Atriplex patulum*, L., var. *hastatum*, Gray. In sandy places.
7. *Distichlis maritima*, Raf.
8. *Puccinellia maritima*, Parl., var. *minor*, Watson. In very salt places.
9. *Scirpus pungens*, Vahl.
10. *Juncus bufonius*, L.
11. *Ilea fulvescens* (Ag.) J. Ag.
12. *Rhizoclonium*, probably *Kochianum*.
13. *Rhizoclonium*, probably *riparium* var. *implexum*.

It will be noticed that all of the above species, except No. 10, are of marked halophytic habit, characteristic of salt marshes or sea-coasts. Probably a more skilful collector would find yet other species. One in the list, *Spergularia borealis*, is new to our flora.

It is easy to understand how these plants persist where they are, for the salt water of the springs is sufficiently like the salt water of the sea. But how did they come there? The nearest sea-coast is, in an air line, at least twenty-one miles away, with high hill-ranges between. For the occurrence of such a colony, one of three explanations is possible:—First, the plants may have been transported from the sea-coast by man; but the large number of the species, and especially the presence of the Algæ, is against such accidental introduction. Second, natural modes of dissemination may have carried them from the coast; but the most of them are so little specialized for such locomotion that this is very difficult to believe. Third, under different geographical conditions in the past they may have extended continuously from the sea to this place, but have since become extinct between. This is doubtless the correct explanation, and is homologous with that of the occurrence of isolated Arctic colonies. During the latest post-glacial subsidence this region dipped beneath the sea to an extent estimated by Dr. Matthew at 200 feet.* At that time the sea, bringing the coast plants with it, must have extended up the Kennebecasis, deeply burying these springs, which, as shown by the Intercolonial Railroad levels, are not over seventy feet above present high-tide mark at St. John. The subsequent elevation of the land, with the return of the fresh water, would of course exterminate the Halophytes everywhere except where they could find salt, which happened to be the case at these springs.

There are other salt springs in New Brunswick—in the parish of Upham, and at Bennett's Brook, near Petitcodiac; while others are said to occur on Coal Creek, Queens County. There is also a brook

* Bulletin of this Society, No. 2, page 4.

with slightly saline taste just above Plaster Rock, on the Tobique. Here is a most attractive problem for our local societies — to determine whether other colonies occur in these places.

Halophytic colonies occur about the salt springs near Syracuse, New York, and no doubt at other places in Eastern North America; but they appear not to have been studied from this point of view.

8.—Upon the Manner in which the Bay of Fundy Rivers of New Brunswick empty into the Sea

Read Dec. 7th, 1897; re-written April, 1898.

The remarkable difference between the way in which most of the rivers east of St. John and those west of it fall into the Bay of Fundy must be well known to members of this Society; but I have not seen in our physiographic literature any special reference to its causes. On the one hand, those of the western series — the St. Croix, the Digdeguash, the Magaguadavic, New River, the Lepreau — all have falls where they meet the salt water, and, at least at high tide, fall directly into it from considerable heights.* On the other hand, the eastern series (beginning really not at St. John, but beyond Mispec, which has a fall and belongs with the western series), including the two streams at Quaco, Big Salmon, Little Salmon, Quiddy, Goose, Point Wolfe, and Upper Salmon rivers, and the brooks amongst them, all run evenly into the sea without natural falls. At first the question as to the causes of this constant difference in the two series is puzzling, but really its solution is not difficult.

We notice, first of all, that this feature of their mouths is really characteristic of their entire courses. Thus those of the western series, running all in comparatively open country, consist largely of long dead-waters (in some cases forming large lakes), or stretches with little fall, and often without ledge-rock bottoms, separated by falls over rocky ledges; and it is up one of these deadwaters of the sunken valley to the next fall above that the tide in every case runs. But those of the eastern series, which all run in deep, V-shaped valleys, cut down 400 to 600 feet below the level of an elevated plateau, have bottoms of ledge rock, and run as torrents, but with no vertical falls of any account, and with deadwaters or lakes only on top of the plateau. The question, then, resolves itself into this — what has produced the falls and deadwaters in the one case and not in the other?

* This fact is noted by Mr. Chalmers in his Report on Surface Geology, 1890, N. 13.

Falls in glaciated regions are chiefly the result of the damming or filling of shallow valleys by glacial drift dropped across them at the close of the Glacial Period, by which the water was held back and made to seek an outlet over the lowest point of the rim of the valley, which usually is a rocky ledge. Such dams are easily to be seen at the falls on these western rivers. On the other hand, where long stretches of rapids or of even descents over ledge-rock occur, the river is probably in its pre-glacial channel; and pre-glacial channels usually have no falls, other than small ones due to unequal hardness or jointing of the rock, and hence to uneven erosion, because there was ample time in the pre-glacial ages for any which may have existed to have become eroded out, as all falls are tending to do. In general, then, we may conclude that where falls and deadwaters are, the pre-glacial valleys are more or less filled up, while long series of rapids over ledge-rock, as a rule, indicate a pre-glacial channel. Now, while the western series of our rivers have large portions of their valleys of the dammed-up sort, those of the eastern series show no glacial dams, and no glacial falls — at least in their lower courses; but the channel is always of bed rock, except where thinly covered by gravel and boulders, brought down by the stream itself. But why were these eastern valleys not also dammed by the glacial drift? Was the region not glaciated? Now there is abundant evidence that it was, though probably not so heavily as the less elevated western section. But while the quantity of drift dropped in Southern New Brunswick was sufficient to fill the comparatively shallow valleys of the western series, it could not fill to the tops these eastern valleys of 400 to 500 feet of depth, and, unless they were filled completely to the top, and a little more, the rivers would not be forced out of them, and hence would form neither new falls nor new valleys, but would simply cut out and wash away the glacial dam itself and resume their pre-glacial beds. The depth of these valleys, then, if this explanation be correct, has been their salvation, and the different depths of the valleys in the two series is the real reason for the presence of the falls at the mouth of the one series, and their absence from the other.*

* The same general explanation will no doubt also apply to some other deep valleys, such as that of the Restigouche, which has no falls, but everywhere a rocky channel.

Dr. G. F. Matthew, in remarks made after the reading of this paper, suggested, as subordinate influences at work to aid in producing the differences between the two series, the following: First, the high eastern plateau tended to turn aside the glacial currents into the St. John, and hence less drift was dropped into the eastern than into the western series, which have valleys directly along the line of the glacial flow. Second, the much greater slope of the eastern rivers must have given them greater power to wash out drift. Third, the formation through which the eastern series have cut their valleys is fairly uniform

9.—The Crayfish in New Brunswick.

Read March 1st, 1898.

In the sixth Bulletin of this Society there was published a short paper with the above title. In the *Educational Review* for November, 1889, appeared an article, with some additional information, unsigned, but known to be by the same author. In the proceedings of the United States National Museum, volume XIII., p. 612, in a work by Dr. Walter Faxon, the chief authority on this group, the New Brunswick localities of the two preceding papers are summarized, but no new ones added. Since then nothing further has appeared, nor does a paper by Dr. Faxon, on the Crayfishes, now in press, contain any new data for this region. The subject is of sufficient interest to warrant calling the attention of the Society once more to it.

Only a single species of Crayfish is known to occur in New Brunswick —*Cambarus (Astacus) Bartonii* (Fabr.) Gir. It has been found abundantly in the valley of the St. John (into which it has no doubt spread from Penobscot waters), in the Restigouche, Upsalquitch, and Miramichi; but it has not been reported from the Nepisiguit, St. Croix, Richibucto, Petitcodiac, nor from Nova Scotia nor Prince Edward Island. As it cannot live in salt water, it probably has not spread into either of the latter provinces, but it ought to occur in other New Brunswick rivers, especially those connected by low, swampy portages with the Penobscot or St. John. The distribution of single species in relation to the influences controlling it is always of much scientific interest, and members of this Society should be on the watch for additional data in this case.

The Crayfish cannot be mistaken for any other animal. It is like a miniature lobster, three to four inches long, of a dark, ashy-brown color. It lives only in fresh water, and forms burrows in alluvial lands.

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in texture, while the western valleys have cut across many bands of different composition and hardness, producing an alternation of deeply eroded, with less eroded, stretches. The filling of the former by drift would force the rivers to seek new outlets over the harder ridges Practically, however, the alternating bands are too broad to have had much effect of this kind, and an inspection of the geological map of Charlotte shows that there is no relation between positions of the falls and the transition between formations. Fourth, post-glacial changes of level, known to be going on, may have buried falls once existing at the mouths of the eastern series, as they have done in the case of the St. John, off Partridge Island. But against the former presence of such falls on the eastern series must speak the fact that there are at present none above the mouths, as on the western series.

10.—The Marine Invertebrates of the Western Part of Bay Chaleur.

Read March 1st, 1898.

There is no part of our marine invertebrate fauna so little known as that of the western part of Bay Chaleur. The subject has been studied for the Bay of Fundy by Stimpson, Verrill, and members of this Society, and for Northumberland Strait by Whiteaves, and the works of these investigators are well known: but for Bay Chaleur, except references by Whiteaves to dredgings at its mouth, and scanty notes by Bell (Canadian Naturalist, IV, 197) on Caraquette, with a single reference to Dalhousie, together with a reference by Morse to the occurrence of *Littorina litorea* at Bathurst in 1855 (Bulletin Essex Institute, XII, 176), there appears to be nothing in the literature of the subject. Yet the question as to what invertebrates occur in the western part of that bay is of considerable interest in connection with the distribution of the southern colony so remarkably developed along our North Shore from Caraquet to Bay Verte, the history of which may be found fully traced in the Transactions of the Royal Society of Canada, VIII, iv, 167–185, and by Upham in American Journal of Science, XLIII, 1892, p. 203. It was therefore natural that during a visit to Dalhousie and Campbellton in August, 1896, I should examine the shores with some eagerness. As it was time of neap tides, I could not see all of the littoral fauna, but to my surprise, what I did see showed no trace of the southern species which I had expected to find there. At Campbellton the Restigouche River makes the water brackish and the shores muddy, conditions which result always in a sparse fauna. At Dalhousie, however, the abundant species were *Mya arenaria*, *Macoma fusca*, *Mytilus edulis*, *Littorina palliata*, *Tectura testudinalis*, small crabs, a small starfish probably *Asterias littoralis*, and many Bryozoa, etc. *Littorina litorea* was, however, very rare, and I could not find a single specimen of *Purpura lapillus*. Stranded on the beaches in abundance was a large medusoid jelly-fish resembling *Cyanea arctica*, though often of a deep amethyst color. *Fucus vesiculosus* and *nodosus* were abundant, the former less so than the latter. In fact the general aspect of the shore forms, including the dead shells cast up on the beaches, was much more like Passamaquoddy Bay than like Shediac Harbor, which I visited last summer, and which has the southern colony. It must be noted, however, that Bell reports *Crepidula fornicata*, a decidedly southern form, from Dalhousie, but I saw no trace of it. In general, then, these notes,

scanty as they are, seem to show that the southern fauna is but slightly represented at the head of Bay Chaleur. Though the summer temperature of the water seems high, it is probably, owing to the proximity of deeper water and more considerable tides, lower than at Shediac, and a little below the surviving point for these southern forms; and perhaps also the more rocky character of the shores is unfavorable to sand-loving species such as most of the southern ones are. Dredging may yield some other forms, though the general character of the coast does not promise a rich fauna.

11.—A Natural History of New Brunswick projected in 1771.

Read March 1st, 1898.

From June, 1770, until June, 1771, Lieut. William Owen, R.N., lived at Campobello, and his journal, part of which has been printed by the Historical Society, contains in the yet unpublished parts some items of no little scientific interest. Thus, under date of October 1st, 1770, he says that, when near Indian Island, he "made here two hauls of the trawl, but took nothing material except a few curious shells, and other sub-marine productions." No doubt this is the earliest existent reference to dredging in New Brunswick waters. Three years earlier he speaks of dredging off the coast of Massachusetts and finding scallops, and "sea-eggs, starfish, coral, weeds and other curious sub-marine productions." During the entire year at Campobello he kept a very careful meteorological record of temperature, wind direction and force, and general weather, the whole given in full in his journal. This is no doubt the earliest record kept in New Brunswick, and is so full and carefully made that it must be of much more than antiquarian interest. But most important of all is the following passage:

"It was his [i. e., the author's] intention (and some time before he left the island he began) to make very particular observations on the quantity of rain and snow that fell; the greatest depth of the snow upon a plain; the depth the frost penetrated into the earth; the nature and quality of the soil, and the different strata under; some remarks in the three kingdoms — animal, vegetable, and mineral; the progress of vegetation; the migration of birds and fish; the seasons for the spermaceti whale, cod, haddock, and pollock fisheries, as well as the river fisheries of sturgeon, salmon, shad, bass, and alewives; the mode and time of killing seals; the Indian's seasons and manner of hunting for their furs and peltries; their fishing and fowling; the mode and best season for hunting the moose or orignal, the cariboo, the fallow deer, and every other miscellaneous matter or event that might occur. This work he left to be carried on by a sober and ingenious young man he left there, who was, unfortunately, lost in the "Owen" (with all her crew and passengers) on his return to England eighteen months after."

This comprehensive plan, even though not carried out, entitles Lieut. Owen to a place in the list of naturalists who have worked in New Brunswick, and his name would come next after that of Nicolas Denys, whose natural history of the Maritime Provinces, published at Paris in 1672, is the foundation work for our natural history.

12.—On the Physiography of the Basin of the Mahood (Lepreau) Lakes.

Read April 5th, 1898.

At the head of the Lepreau River lies a chain of small lakes known to a few fishermen but hitherto unvisited by any naturalist. No officer of the Geological Survey has been there, and, aside from a brief mention of them in one geological report, there does not seem to be a single reference to them in all scientific literature. The published maps show them inaccurately in details, and the manuscript plans in the Crown Land Office differ much from one another and from the actual geography. There is perhaps no part of the province so near to settlements which is so little known. Last summer, with three companions, I spent two weeks—July 10th–24th—on the lakes and river, and, although we found little of interest, it is, nevertheless, some satisfaction to know just what kind of a country it is from the scientific standpoint.

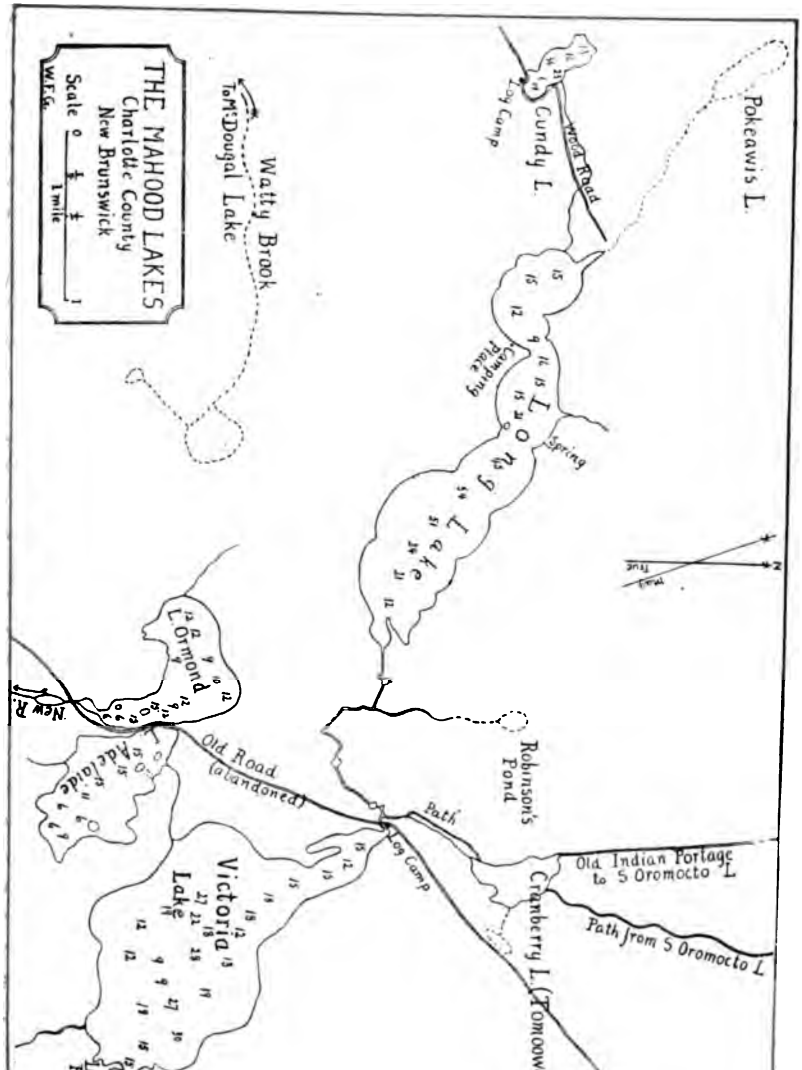
Most of the lakes in this chain were first surveyed and mapped in 1837 by William Mahood, Deputy-Surveyor for Charlotte County. As there is no name in use for them taken collectively, I have ventured to apply Mahood's name to them, to preserve the memory of a worthy man and skilful surveyor, who did more than any other to make known the geography of Charlotte County. His name is already applied on some maps to the lake commonly called Disappointment or Mistake Lake, which, though not shown on the accompanying map, may be considered as belonging to the same series. The names of these lakes were apparently all given by Mahood—Victoria in honor of the young Queen who in that year came to the throne, Adelaide for the Consort of the King who had just died, Ormond in honor of an Irish Earl from near whose seat Mahood had come; while Tomoowa, now obsolete, seems Indian, and is perhaps that of a guide. Long Lake is descriptive, but was not added until after the others, which is true also of Robinson's Pond. Six miles to the southeast, and emptying into the Lepreau, lie two other lakes, now commonly known as the Hurd Lakes, but on the maps called Coronary and Rooskey, and these names also, as the late Mr. Andrew Inches has told me, were given by Mahood in

remembrance of those places in Ireland, near which his boyhood had been passed. The accompanying map is based partly on Mahood's original plan, partly upon others, with many corrections based on angles taken by compass by myself. Though still far from accurate, it is yet much nearer the truth than any other of that region known to me. The depths were measured by me.

The Mahood Lakes lie in an undulating country, near the summit of a minor watershed, from 550 to 600 feet above sea level. They drain eastward through the Lepreau, but interlocking with them are streams which flow north, west, and south. The country is built of granite, heavily glaciated, and across it run trains of immense, and often angular, boulders. It is to these trains of boulders that the lakes owe their very existence, for in all cases the outlet is over a dam of this kind, a dam so hard to erode and so impossible to remove that the waters have not been able to cut their way through it. The lakes are all shallow, even the deepest part of Long Lake not exceeding sixty feet. We have here all of the conditions and characteristics of a land of bad drainage. Mr. Chalmers, simply from an inspection of the maps, has described this region with perfect exactness, and I cannot do better than to quote his words, especially since they contain the only printed scientific reference to these lakes :

> "The great number of small lakes which dot the surface of the region about the head-waters of the Musquash, Lepreau and New rivers is a somewhat remarkable feature. The region here would seem to be a comparatively undrained one. The small volume of the rivers, their consequent feeble erosive power, and the hardness of the rocks, are such that the rivers have been unable, since the glacial period, to cut channels sufficiently deep to drain off these lakes. These rivers and lakes are therefore in much the same condition as in their early post-glacial history, and will necessarily remain so for a long time owing to the slow wearing processes going on."—(Geological Survey Report, 1890, N, 15.)

The lakes may be reached by a foot-path from South Oromocto Lake, or by an extremely bad wood-road from MacDougal Lake ; and by the latter route we were portaged in with canoes and baggage. Formerly there was a winter road from Lepreau Village to Lake Victoria, but with the passing of lumbering this was abandoned. In 1839 a road, locally called the "Old Magaguadavic" or "Military Road," was surveyed from St. George Village to the Nerepis, and passed among these lakes by the route shown on the map. Its course is shown fully on Wilkinson's map. It was little more than a track through the woods, was soon abandoned, and now not a trace of it remains.


THE MAHOOD LAKES
Charlotte County
New Brunswick
Scale
1 mile
W.F.G.
Watty Brook
To McDougal Lake
Pokeawis L.
Gundy L.
Log Camp
Wood Road
Camping Place
Long Lake
Spring
L. Ormond
New R.
Old Road (abandoned)
Adelaide
Robinson's Pond
Path
Log Camp
Victoria Lake
Old Indian Portage to S. Oromocto L.
Path from S. Oromocto L.
Cranberry L. (Tomoowa)
Lepreau R.
True
Mag.

Cundy is a small lake amidst dense woods in an undulating country. Its height above mean sea level is, according to my aneroid measurement, about 600 feet. Its approximate size, shape and depths are, like those of the remainder of the chain, represented on the accompanying map.

Of Pokeawis, I know nothing, except that the stream which empties it is much larger than that from Cundy. Like other features dotted in on the map, it is added from other plans, principally one loaned me by Mr. George Barnhill of St. John, who knows this region more intimately than any other man.

Long Lake lies about forty feet lower than Cundy. Its shores rise into low rolling wooded hills, and it occupies a winding valley, though I do not think it is an old valley of erosion, but rather is a basin formed by a dam amongst irregular hills. It has the typical appearance of a northern lake of the granite country, with dark, somewhat turbid water, shores of granite boulders lined up by action of the ice to almost the regularity of masonry, with a dense evergreen forest above and overhanging them. It has one sandy point, however, and altogether is not unattractive. At its lower end it empties amongst great angular granite boulders by a straight, rapid passage of one hundred yards, falling about four feet into a deadwater below. From this outlet down to Victoria is a thoroughfare winding about amidst a heath bog which occupies the shallow basin of an old lake, and expanding at times into pools of considerable size. Robinson's Pond is said to be small, shallow, and marshy, and the same is true of Cranberry or Tomoowa Lake, which is rapidly being overgrown by the bog from its southern end.

Victoria Lake is well known to some St. John people, for it is famous for its trout fishing. For the most part its shores are of the typical boulder sort, but on the west and southwest occurs much attractive white sand beach, which has no doubt been derived by wave and ice action from the ridge of sand and gravel along the western side. This ridge extends out northward in the peninsula shown on the map. The height of this lake above sea level is, by aneroid, about 550 feet*. It is rather a shallow lake, especially in its western part, which is probably due to the washing out of the sand and gravel from the western shore. At its eastern end appear hills of considerable height, which have been burnt over and are partly covered with a low second growth bristling with great rampikes. Victoria is on the boundary between the great burnt country, of which I shall presently speak, and the unburnt country to the westward.

* See the next note of this series

Southwest of Victoria, some forty feet higher and emptying into it, lies Lake Adelaide, a shallow lake with wooded shores. The same description will apply to Ormond, and both are typical of badly-drained granite country. Between Adelaide and Ormond is nothing but a glacial dam of morainic materials only a few yards wide; indeed in places it is hardly wide enough for the road which was once intended to run over it. Yet Ormond stands about thirteen feet higher (thirteen feet ten inches according to Mahood's map) than Adelaide, and drains into New River. The dike between must be composed largely of clay in order to form so efficient a dam. This, however, may not be perfect, for it is said that at the western end of Adelaide, some eighty feet from shore, is a large "bubbling spring," and moreover, that attempts made in the days of lumbering to "flood" Ormond were always unsuccessful. These two facts may be connected, and mean that there is a high-water communication between the two lakes.

From this brief account it will appear that these lakes do not differ in any important character from innumerable others in the granite areas of the province, and they possess no special scientific attractions.

The Lepreau River flows from the eastern end of Lake Victoria, and runs to the eastward eight miles, where it is joined by the North Branch. The country slopes away rapidly in that direction, and is of the roughest granite character, so that the river, in addition to its considerable fall, is constantly obstructed by trains of boulders and ledges which it has been unable to erode away. While it has no marked falls in that interval and very few deadwaters (only two or three), it has innumerable rapids, particularly of the kind over and among boulders. Probably no stream in the province carrying an equal volume of water is so difficult for canoe navigation. It required of us, at a time when the water was fairly high, two long days of the severest labor, with twenty portages by actual count, all along the rough bed of the river, to cover this eight miles to the North Branch. The entire country has been burnt over, and so thoroughly that it can bear no second growth. The very soil has been burnt and washed away, and nothing shows but the bare granite boulders, with scanty moss and an occasional low bush, while the great rampikes show how noble a forest once clothed this land. The view from some of the low hills as one looks eastward is the most desolate it is possible to imagine; to me the Arizona deserts are less forbidding. It is said that this country was burnt shortly after the Saxby gale, which levelled immense quantities of timber, and this gave the fire tremendous power. It

started near Lepreau Village and swept northward and westward. Earlier than that date a fire started near Musquash and burnt the country to the eastward.

At the North Branch the river turns to the southward and flows twenty miles to the salt water. The river continues to fall much, though with no large falls, until Eagle Mountain is reached. This mountain, which by direct aneroid measurement we made 520 feet above the river at the brook just above it, and about 850 feet above sea level, affords a splendid view in all directions, including especially the burnt country. Here, again, one has forced upon him a conception of the awful power of these great forest fires. The granite hills are not only stripped forever of their covering, but are scorched and bleached. Before one's eyes lies, white and grinning, the very naked skeleton of the land.

Below Eagle Mountain the navigation becomes easier. Just below Squaw Mountain the sharp boundary between burnt and unburnt country is passed, and one comes with joy into the grateful shade of the woods. Here, too, the granite country is left behind, and the character of the river changes. It now runs rapidly, but smoothly, over a gravel bottom, justifying its Indian name of *Wis-e-amk-ay-nis*, or *gravelly river*, and becomes a charming canoe-stream. Its water seems to become clearer the farther it is from the lakes, and it is richer in water-plants than any other stream I have noticed. Its course is broken by three great falls, and one or two minor ones ; the former are known, respectively, as Ragged, Big and Little Falls. Ragged and Big Falls are each over eighty feet high, could very easily be dammed, and have immense basins above them in which great quantities of water could be stored. This fact, together with the ease with which water could be stored in abundance among the lakes at the head of the river, is likely to make the Lepreau a valuable river in the time to come when economical transmission of power and increasing cost of fuel will direct attention to natural sources of power. Finally, the river falls over a ledge into salt water at Lepreau Village.

13.—On New Heights in New Brunswick, determined with Aneroid in 1897.

Read April 5th, 1898.

During the summer of 1897 I made, with a good aneroid barometer, a number of measurements for heights above sea-level in New Brunswick. These have been corrected for weather changes by comparison with readings from the barometers of the meteorological stations at

Fredericton and St. John. I wish here to thank Dr. Harrison of the University, and Mr. Hutchinson of St. John for lists which they have supplied to me. Mr. Hutchinson also, on July 9th, determined the error of my aneroid, and this of course has been taken into account in calculating the results below. Many of my readings were taken at times so different from those of the two stations that I have rejected them, and I have kept only those of the five important points here mentioned. In none of the cases admitted did the time between my reading and those of one of the stations exceed twenty-four minutes, except in one of the Mount Pleasant observations, when it was sixty-six minutes, on a very clear day. It will be noticed that in all cases comparison with figures from the Fredericton Station gave results higher than those from the St. John Station. The list of readings from Mr. Hutchinson was reduced to mean sea-level, while those from Fredericton were for a height 164 feet above it ; and the constancy of the discrepancy suggests that the height assigned to the Fredericton Station is too great. I do not give all of the figures in detail, since at the best, like most other measurements of this kind which have been made in New Brunswick, they can be but approximations, but I have calculated them carefully and repeatedly, and think there is no error in the figuring. The three places first mentioned have not been measured before :

Surface of Victoria Lake, Charlotte County.—Saturday and Sunday, July 17 and 18.—Two observations compared with Fredericton, 624 and 614 feet; two compared with St. John, 480 and 510 feet; mean of all, 557 feet. This agrees with another measurement made July 10th, which by direct, uncorrected reading made Cundy Lake about 500 feet above the railroad at Bonny River, and hence about 600 feet above mean tide. Cundy is about forty-five feet above Victoria, which thus would be 555 feet above the sea.

Eagle Mountain, Charlotte County (near boundary of Kings).—By direct measurement, July 20, this mountain was 520 feet above the mouth of Eagle Mountain Brook; latter, by comparison with Fredericton, is 334 feet above the sea; hence Eagle Mountain is 854 feet.

Mount Pleasant, Charlotte County.—Aug. 12 and 13.—By comparison with Fredericton, 1,224 feet; with St. John, 1,175; mean, 1,200. Gesner, in his first Geological Report, guessed its height to be 1,300 feet, and Mahood, upon one of his MS. plans in the Crown Land Office, guessed it at 3,000 feet.

Bald Mountain, on the Kings-Queens Boundary.—Aug. 14. —By comparison with Fredericton, 1,494 feet above mean sea-level; by comparison with St. John, 1,430 feet; mean of the two, 1,462 feet. Conditions were particularly favorable, and my observations covered the time of both stations. Gesner, in one of his reports, guessed its height to be 1,120 feet; the Surface Geology map, probably following Gesner, gives it as 1,120 feet; Mr. William Murdoch of St. John, by theodolite angle, has given it to me as 1,390 feet.

Cherry Hill, Harvey. —Sept. 3.—By direct measurement, above the track, 315 feet; by comparison with Fredericton, 884 feet above mean sea-level.

ARTICLE VI.

BATRACHIA OF NEW BRUNSWICK.

BY PHILIP COX, PH.D.

Read April 5, 1898.

As the following list records only the writer's personal observations, it must be found to contain fewer species than have hitherto been assigned to the province. He does not believe it includes all our batrachian fauna, though he regardsthe occurrence here of some forms, included in early publications, as extremely doubtful. It is the result of many years' research in various parts of the province, made as reliable as possible, by means of the views and opinions of distinguished specialists, who were always consulted on doubtful matters.

Among the Urodela, *Desmognathus fuscus*, Rafinesque, and *A. opacum*, Gravenhorst, the latter closely related to *A. punctatum*, a common salamander, are both likely to be found. They have a place on old lists.

Of the Anoura, *Rana septentrionalis*, Baird, and *R. cantabrigensis*, Baird, may likely be found in the western part of the province, or in the lake region near the Bay of Fundy.

AMBLYSTOMIDÆ.

Amblystoma punctatum, L. Yellow-spotted Salamander.
Generally distributed, but not abundant.

A. jeffersonianum, Green. Granulated Salamander.
Common in river valleys of the southern parts of the province; rare in the northern.
Oromocto Island, Sunbury Co. Roy McLean Vanwart.

A. jeffersonianum, var. *laterale*, Hallowell.
Occurring with the last; but more abundant, and characteristic of our fauna.

PLETHODONTIDÆ.

Plethodon cinereus, Green. Red-backed Salamander.
Same range as *A. jeffersonianum*, but rather rare. Have not collected it on the North Shore.

P. cinereus, var. *erythronotus*, Green. Red-backed Salamander.
Specifically related to the last, but with dorsal stripe very red. Common, and characteristic of our region.

P. glutinosus *(Salamandra glutinosa)*. Green. Blue-spotted Salamander.
Very rare, and only in the southern parts of the province.

Spelerpes bilineatus *(Salamandra bilineata)*. Green.*
Small brook at Curry's Mountain, York Co. Roy McLean Vanwart.

S. bilineatus, var. *borealis*. Baird.
The typical form in New Brunswick.
Valley of the St. John.

DESMOGNATHIDÆ.

Desmognathus ochrophæa, Cope. Painted Salamander.
Oromocto Island, River St. John, *fide* Prof. E. D. Cope. Its first record.
In gratitude to this distinguished naturalist, whose kind heart and facile pen were ever at the service of the humblest plodder, I may be pardoned for quoting from a letter, among the last he ever wrote: "The specimen of *D. ochrophæa* represents a variety with a spotted belly, such as I never saw in the United States."

PLEURODELIDÆ.

Diemyctylus viridescens, Rafinesque. *(Salamandra millepunctata,* Storer*)*. Spotted Newt.
The most aquatic of our Salamanders. In all suitable lakes and ponds.

D. viridescens, var. *miniatus*, Hallowell.
A smaller, red, finless, and less aquatic variety, always found with the former. Represents, probably, a mere seasonal phase.

BUFONIDÆ.

Bufo lentiginosus americanus, LeConte. Toad.
Very common and variable. A more extended and careful examination may show the occurrence here of at least two sub-species.

HYLIDÆ.

Hyla pickeringii, Storer. Tree-Frog.
Found everywhere.

H. versicolor, LeConte. Tree-Frog.
Seems to be rare. Have heard its note in several parts of the province, but seen only one specimen, collected in Gloucester County, and now in the museum of the Miramichi Nat. Science Association, Chatham, N.B.

RANIDÆ.

Rana virescens *(Rana halecina)*, Kalm. Green Frog.
Generally distributed over the province.

* Striped-back Salamander.

R. virescens brachycephala, Cope. Green Frog.
A short-headed and stouter form; the dominant type in New Brunswick.

R. palustris, LeConte. Marsh Frog.
In the southern part of the province; not common. Have not met with it in the four northern counties.

R. catesbiana, Shaw. Bull-Frog.
All over the province, but local. The most aquatic of our frogs.

R. fontinalis, LeConte. Spring-Frog.
Generally distributed; varies greatly. In *fontinalis* I recognize a stout, pustular form, the prevailing type in the northern counties.

R. fontinalis nigricans, Agassiz. Spring-Frog.
A small, black variety, or sub-species met with in rocky brooks. Noonan Brook, Sunbury Co.

R. fontinalis clamitans, Holbrook. Spring-Frog.
A long-legged, slender, less webbed and less aquatic variety, which I have collected only in the St. John valley. Mr. C. F. B. Rowe has taken specimens in the vicinity of St. John.

R. silvatica, LeConte. Wood-Frog.
Occurs generally, but not abundant. [Mr. C. F. B. Rowe has noted that this species spawns several weeks earlier than other frogs.—Ed.]

APPENDIX.

REPORT ON THE SUMMER CAMP AT QUACO.

Held July 1-10, 1897.

In past years the Society has held Summer Camps at different points of scientific interest in the province, the object being twofold—(1) to enable members to acquire experience in field work, (2) to stimulate, in the localities visited, an interest in the study of nature.

In July last a camp was held at Quaco, this village having been selected as presenting a number of advantages for our purposes. About thirty persons attended, and in every way the camp was a success. The residents of Quaco attended the evening lectures, and a strong interest was aroused in our work. Lectures were given by President G. U. Hay, Dr. G. F. Matthew, Prof. L. W. Bailey, Prof. A. W. Duff, and Dr. W. F. Ganong. Field work was carried on daily under the different leaders, and many important observations were made on the geology, physiography, and botany of the surrounding region.

Professor Bailey and Dr. Matthew led the geological parties, President Hay and Dr. Ganong had charge of the botanists, and Professor Duff carried on tidal observations in the harbor. Messrs. Berton and Rowe made a collection of the small mammals, reptiles and batrachians. The camp was under the management of the Secretary of the Society, Percy G. Hall, and valuable local assistance was rendered by our resident members—Dr. Gilmour and Geo. J. Trueman.

Report on the Geological Data obtained at Quaco—Summer Camp of 1897.

By Dr. Geo. F. Matthew.

The fine exposures along the coast at Quaco in sea-cliffs of varying height, give excellent opportunities for studying the geology of that district. Here only, in all New Brunswick, is there a formation of the Mesozoic, or Reptilian Age, of sufficient extent and thickness to represent in any adequate degree the strata of vast extent in many regions of the earth, which tell the story of this important portion of the world's past history.

Heretofore there has been recognized at Quaco only two members of the Mesozoic system, viz., the bright red sandstones, so conspicuous on numerous cliffs along the coast, and the overlying pebble beds. A third member of this system, probably as important in volume and thickness as the two lower ones together, was recognized in our excursions along the eastern part of the shore. This member is so like the Lower Carboniferous rocks that it has heretofore been confounded with them. The proofs that it is Mesozoic are the following: 1. Its lowest bed are found to graduate by alternation of measures into the pebbly member of the heretofore recognized New Red Sandstone 2. Its conglomerates are full of rounded fragments of dark-red shale, which in this district can have no other source than the Lower Carboniferous rocks. 3. The plant remains found in its grey sandstone layers (though poorly preserved), by the flabellate leaves with stout petioles, and the leathery strap-shaped leaves that are found, as well as by the absence of Sigillaria, Lipidodendron, and Calamites, appear to be a Mesozoic assemblage, and certainly are not of the ordinary Carboniferous type.

This upper member of the Red Sandstone series holds the shore from Melvin's Beach to Fown's Beach; it also appears on the shore at Berry's Beach, beyond which in going westward it passes inland; and it has a considerable width behind Quaco Village.

Our party visited the intrusive trap and manganese deposits at Quaco Head. The trap has forced its way through the red sandstones, partially altering it and discharging the red color from the sandstone for some distance from the line of contact; the trap also becomes fine grained and loses its feldspar crystals near the contact with the sandstone.

The shores at Quaco and the surface deposits there abound with pebbles derived from the pre-Cambrian volcanic rocks of the hills inland. There is the greater profusion of these because the great pebble beds of the middle member of the Mesozoic or Red Sandstone system abound with fragments from this source At Vaughan's Creek (McComber's Beach) the pebbles of the conglomerate are mostly of purple quartzite and felsite, sometimes without any admixture of sand, so that when the calcareous cement which holds them in place weathers away, they fall to the beach in great numbers, and repeat in modern times their accumulation as beach-shingle in the Mesozoic Age.

Tidal Phenomena at Quaco.

By Prof. A. Wilmer Duff.

The point that the writer was chiefly interested in was the occurrence of those somewhat puzzling phenomena called "secondary undulations." Anyone who examines the record of the Kelvin Tidal Gauge at St. John will find that it gives a wave-shaped curve, the heights of which correspond with the time of high water and the hollows with the time of low water; but, in addition, he will discover that on this main curve there are smaller indentations, indicating minor risings and fallings of water level, the whole time from greatest of these minor undulations to the next greatest rise being, on an average, about forty minutes. These small and comparatively rapid oscillations of level are the so-called "secondary undulations," and the time of forty minutes required for them to complete their cycle of changes of level is called their period.

The author had already shown* that these secondary undulations could be explained as due to a long, slow oscillation of the whole body of water between the New Brunswick and the Nova Scotia coast, the vibrations being similar to these that are set up in a wash-basin full of water when it is disturbed. It became, then, an interesting point to determine whether the rest of the body of water in the bay partook of this same general motion, and whether the period was the same as at St. John. The author fully expected that it would be.

With this in view, the tide gauge described in a former communication† to the Society was used at Quaco. On three different days the gauge gave clear records of "secondary undulations;" but, contrary to his expectations, the period in all cases was 12½ minutes. This was a somewhat puzzling result, until it occurred to the writer to examine the chart of the bay off the New Brunswick coast in the neighborhood of Quaco, when he found that the presence of a reef called the Quaco Ledges, and the two headlands that project into the bay above and below Quaco, respectively, marked out a smaller bay (open, it is true, to the east), in which the water would naturally oscillate in a period of its own, determined by its own dimensions. From the smallness of its dimensions these oscillations might be expected to be much quicker than those across the bay at St. John, although the irregularity in shape of this small bay precludes any attempt to calculate mathematically what the period of the oscillations of the water in it would be.

*See American Journal of Science, Vol. III, No. 17, 1897.

†See Bulletin XV of the Natural History Society of N. B., 1897.

The author has thus been led to the view that a large body of water such as the Bay of Fundy is broken up into smaller areas of oscillations, each having its own characteristic period as determined by its dimensions. In a part of the bay where there is a comparatively free, unobstructed sweep from side to side, as between the general contour of the New Brunswick coast at St. John and that of the opposite Nova Scotia coast, the period of oscillation would be that of the whole bay, or perhaps half that dimension, since such a large body of water might have itself a tendency to divide up into two halves, each oscillating in half the period that the whole would take if set into free swingings to and fro.

The author hopes on future occasions to explore other parts of the bay in the same way, with a view to confirming or refuting this hypothesis.

It should be noted that the point here considered is merely the cause of the periods characteristic of these motions. How the motions themselves originate, what causes the initial disturbance, is a different question. The difference is similar to the difference between the enquiry, What disturbs a wash-bowl, and, the other enquiry, what determines the rate at which the water "wish-washes" when disturbed? It can, however, hardly be doubted, I think, that the first disturbance in the bay comes from the action of wind in a storm, since an examination of many cases of "secondary undulation" at St. John and at Quaco seems to show that they are only prominent when the sea has been disturbed by a gale. Thus there need be none of the mystery as to the origin of "secondary undulations" which some writers delight in attributing to them.

Report on the Botany of the Summer Camp.

By G. U. Hay.

During the ten days that the Society was at work at Quaco and vicinity, several botanical excursions were made about the village, and one to Salmon River. There was much interest manifested in these excursions and in the lectures given in the evenings, one by Dr. W. F. Ganong, and the other by Mr. G. U. Hay. Many smaller gatherings were also held for the study and analysis of plants, in which many of the young people of Quaco took part. The examination of the beach in front of the village revealed an absence of plant and animal forms that might be expected to occur here. The two common forms of

Fuci—*F. Vesiculosus* and *F. Nodosus*—were common. *Corallina officinalis* was quite abundant in pools, with several species of *Ulva*. On the adjacent cliffs of West Quaco, clumps of the brilliant *Sedum Rhodiola*, with patches of *Ligusticum Scoticum*, form a pleasing contrast to the dark back-ground of trap rock. In the salt marshes above the limit of the tide the vegetation was more varied and abundant. *Atriplex hastata*, *Salsola kali*, *Statice limonium*, *Carex panciflora*, *Carex norvdegica*, *Carex maritima*, *Comandra livida*, *Glaux maritima*, and other forms common to such a habitat, were observed. Further up from the shore were *Kalmia glauca* in great abuundance, *Cypripedium acaule*, *Andromedra polyfolia*, etc., and the honeysuckle, *Lonicera involucrata*, its first recorded appearance in the southern part of the province.

The visit to Salmon River did not result in the discovery of any rare species of plants. This river, with its narrow gorge and lofty hills on each side, reminds one strongly of the Restigouche.

At Greer Settlement, five miles from Quaco, the beautiful *Cypripedium spectabile* was found in great abundance, and on the roadside near by a few groups of *Scrophularia nodosa*, its first recorded appearance in this province. This plant belongs to Southern New England and the Middle States. It was thriving well here, but whence or how it came no one in the vicinity could tell. The abundance of the showy blossoms of the *Cypripedium* made our lecture hall during the remainder of our stay a place of beauty, from the presence of this orchid of tropical-like richness of color.

A visit to the ravine near Rourke's River, during the half-day previous to our departure, was one of the most pleasant outings that the botanists enjoyed. Amid the sandstones and calcareous slates, there was growing, in the greatest profusion, *Cystopteris bulbifera*, *Cystopteris fragilis*, and other ferns; *Geranium Robertianum* in great luxuriance, *Habenaria rotundifolia*, *Equisetum scirpoides*, etc.; and on a hill near by one specimen of *Echium vulgare*.

Zoology.

The beaches at Quaco show little animal life, and that only of the very commonest forms. There are few tide-pools, and these are rather barren.

Several hauls of the dredge were made in Quaco Bay, but with disappointing results. A few dead shells and two or three living forms

of the commonest species were brought up from muddy bottoms. The conditions off Quaco are not at all favorable to an abundance of animal life, which clusters rather about sheltered passages where gentle tidal currents sweep constantly through.—[W. F. G.]

Origin of the Name Quaco.

By Dr. W. F. Ganong.

There is no real doubt as to the origin of this word. By the Micmacs it was, and is, called *Gool-wah-gah-kek* (the first *g* very obscure and easily missed), from *Goolwaakw*, the hooded seal, with the locative, *ek*. Hence the word means, "Place of the hooded seal." It first occurs on the Franquelin-DeMeulles map of 1686 in the form *Ariquaki*, which, allowing for the French sounds, for the omission of the obscure preliminary *g*, for the replacement of the *l* by *r*, as was invariable with the French, and for the omission, common on French maps, of the final *k*, is plainly from the Indian word. It next appears on Blackmore's map of 1712 as *Roquaque*, of which the relation to the French form is plain, and later plans have *Oreequaco*. Finally, on a plan of 1762, it first occurs in its present form. Several other explanations of the word have been given, but in no case has any evidence been adduced in their support. The history of the word is traced with greater fulness in the Transactions of the Royal Society of Canada (new series), Vol. II, section ii, page 264, and in a letter in the St. John Daily Telegraph, Nov. 16, 1896.

Another word, in the same vicinity, of great interest is *Point St. Tooley*, applied locally, though on no chart, to the eastern headland of Quaco Bay. This is probably a survival, and English corruption, of Point St. Louis, given by Champlain in 1604. Champlain named a river at Quaco (probably Vaughan's Creek), *Riviere de St. Louis*, and it seems probable, though there is no proof of it, that this name became extended to the cape, and was passed along by the French and New England pilots down to the present.

REPORT ON ZOOLOGY.

The Committee beg to submit the following notes. Dr. Cox has prepared a list of the Batrachians of the province, which will be found in another part of this bulletin. Several inquiries have been made for a list of our insects, and the Committee hope to have a list of our Butterflies and Hawk Moths prepared in time for publication in the next bulletin. Dr. Cox has kindly furnished the notes on fishes for this report.

Additions to the List of New Brunswick Fishes.

(For Catalogue, see Bulletin XIII, 1896.)

Siphostoma fuscum (Storer). Jordan and Gilbert. Common Pipe-fish.
A single specimen taken in a smelt bag-net in Miramichi Bay, February, 1898, and donated to the museum of the Mir. Nat. Hist. Association.

Atherina notata, Mitchell. Silverside.
Abundant around the shores and islands of Mir. Bay in mid-summer.

Aspidophoroides monopterygius (Block). Storer. Alligator-fish.
One found among smelts in a net in Mir. Bay, Feb., 1898, and donated to museum of Mir. Nat. Hist. Association.

Phycis tenuis, Mitchell. White Hake.
Not uncommon in Mir. Bay in early part of winter.

Pleuronectes glaber, Storer. Smooth Flounder.
Miramichi Bay and Bay des Chaleurs, but not abundant.

Birds.

The numbers refer to the list of birds printed in Bulletin 1, 1883.

Section A.

(Species which occur in St. John and Kings Counties.)

6. Bluebird (Sialia Sialis). Only three authentic instances of occurrence in the province said to be known.

Note.—A female collected by M. G. B. Henderson on October 20th, 1897, on Loch Lomond road, about four miles from this city. Several seen.

76. Rusty Blackbird (Scoleophagus Carolinus). A male collected on April 2nd, 1898, by A. Gordon Leavitt.

101. Red-headed Woodpecker (Melanerpes Erythrocephalus). Only reported from "Garnett's."

Note.—A male collected at Little Lepreau on June 5th, 1897, by G. L. Hanson.

114.—American Hawk-owl (Surnia Ulula Caparoch). Given as rare, and none reported for this immediate vicinity.

NOTE.—A female collected by Byron Lingley at Lily Lake on November 24th, 1894. Also a female collected at Little Lepreau by G. L. Hanson on January 29th, 1896.

136. Black-crowned Night Heron (Nycticorax nycticorax Naevius). Only a few observed near St. John.

NOTE.—Male collected at Little River, October 24th, 1895: two males on September 5th, 1896, by M. G. B. Henderson; and a female, at same place, on September 7th, 1896, by Wm. Hare.

197. Ruddy Duck (Erismatura rubida). Only two instances of its occurrence known.

NOTE.—A. Gordon Leavitt has a pair, male and female, in the same plumage (brown and grey), which were brought to him by a farmer living near Quaco. They were shot on October 23rd, 1893.

SECTION B.

(Species which have not been observed in St. John or King Counties, but which occur in other parts of the Province.)

227. American Titlark (Anthus Pensilvanicus). On Red Head marsh, on October 9th, 1897, A. Gordon Leavitt collected a female, and on the same day, at the same place, Walter Harrison collected two females.

Lincoln's Sparrow *(Melospiza Lincolni)*. A specimen taken in June, 1897, at Scotch Lake, York County, by W. H. Moore. Mr. Moore also observed two Shore Larks at Macnaquack, February 26th, 1898, and at Scotch Lake, on March 5th, 1898, the White-winged Crossbill.

MAMMALS.

Mr. Geo. W. Bailey reports a specimen of the Grey Squirrel *(Sciurus carolinensis)*, taken in York County. Not before observed, except in Charlotte and Carleton Counties.

A. GORDON LEAVITT.
WILLIAM McINTOSH.
CHAS. F. B. ROWE.
Zoological Committee.

REPORT OF THE BOTANICAL COMMITTEE.

The following are the names (printed in full-faced type) of new plants added to our provincial flora during the past year, and new localities for some rare plants :

89. **Stellaria borealis,** Bigel. Salt Springs, near Sussex. Dr. W. F. Ganong.
91. Arenaria peploides, L. Portage Island, Miramichi. Dr. Cox.
273. Lonicera involucrata, Banks. Quaco. Hay.
366. *a* **Hieraceum pilosella,** L. Charlo, and Eel River, Restigouche. Dr. Cox.
436. *a* **Sabbatia chloroides,** Pursh. St. John. Miss A. R. Warner.
457. *a* **Schrophularia nodosa,** L. Greer Settlement, near Quaco. Hay.
513. *a* **Chenopodium Bonus-Henricus,** L. Chatham. Dr. Cox.
901. Pellæa gracilis, Hook. Loch Lomond, St. John Co. R. B. Gilmour.
902. *a* **Asplenium trichomanes,** L. Loch Lomond, St. John Co. R. B. Gilmour.

G. U. HAY,
Chairman Botanical Committee.

BIBLIOGRAPHY OF SCIENTIFIC PUBLICATIONS RELATING TO THE PROVINCE OF NEW BRUNSWICK, OTHER THAN THOSE CONTAINED IN THE BULLETIN OF THE SOCIETY, 1898.

BY SAMUEL W. KAIN.

Lists similar to the one here given will be found in Bulletins XIII–XV. They contain titles from 1890 to June, 1897. The present list contains titles from July, 1897, to June 1898, with a few omitted from previous lists.

GEOLOGY.

Bailey, Prof. L. W.—The Bay of Fundy Trough in American Geological History. *Trans. Royal Soc. Canada*, 2nd series, Vol. III, Sec. IV, pp. 107–116, 1897.

Belding, A. M.—Bog Manganese in Albert County. St. John *Daily Sun*, December 25th, 1897. (Pub. Anon.)

Dawson, Sir J. W.—On the Genus Lepidophloios. *Trans. Royal Soc. Canada*, 2nd series, Vol. III, Sec. IV, pp. 57–78, 14 pl., 1897.

Matthew, George F.—The Rockwood Bog. (Abstract.)
St. John *Daily Sun*, November 4, 1897.

Studies in Cambrian Faunas:

Part I. On a new sub-fauna of the Paradoxides Beds of the St. John Group.

Part II. Billing's Primordial Fossils of Vermont and Labrador.
Trans. Roy. Soc. Can., 2nd series, Vol. III, Sec. IV, p. 175, 4 pl., 1897.

Mickwitz, August.—Uber Die Brachiopodengattung Obolus. *Eichwald.*
Memoirs Imp. Acad. Sciences, St. Petersburg, 8th series, No. 2, pp. 21-22, 1896.
(Describes fossil shells from Caton's Island, and reviews Dr. G. F. Matthew's studies on the genus Botsfordia.)

Trueman, Howard—Reclaiming the Misseguash Marsh.
St. John *Daily Sun*, December 29, 1897.
(Pub. Anon.)

Whittle, Charles Livy—The Beach Phenomena at Quaco, New Brunswick.
Am. Geologist, Vol. VII, pp. 183-187, 1891.
(Omitted from list in Bulletin XIII)

Genesis of the Manganese Deposits at Quaco, New Brunswick.
Boston Soc. Nat. Hist.. Proc., Vol. XXV, pp. 253-258, 1891.
(Omitted from list in Bulletin XIII.)

Meteorology.

Kain, Samuel W.—Thunderstorms in New Brunswick, 1897.
U. S. Weather Review, Vol. XXVI, pp. 105-106, March, 1898.

McLaughlin, W. B.—Remarkable Sounds heard along our Southern Coast.
St. Croix Courier, March 31st, 1898.
Also *U. S. Weather Review*, Vol. XXVI, April, 1898.

Botany.

Ganong, W. F.—On Raised Peat Bogs in the Province of New Brunswick.
Trans. Royal Soc. Canada, 2nd series, Vol. III, Sec. IV, pp. 131-163, 1897.

Vroom, James—Trees and Forests.
St. John *Daily Sun*, August 2, 1897.

Zoology.

Hall, Ansley—The Herring Industry of the Passamaquoddy Region, Maine.
U. S. Fish Com. Report, 1896. pp. 443-447, map, 1898.

Moore, H. F.—Observations on the Herring and Herring Fisheries of the Northeast Coast, with special reference to the vicinity of Passamaquoddy Bay.
Ibid., pp. 387-442, pl. 1, map, 1898.

Perkins, Henry F.—Notes on the Turtles of New Brunswick.
St. John *Daily Sun*, February 5th, 1898.

METEOROLOGICAL ABSTRACT FOR 1897.

Observations recorded at St. John Observatory. Latitude, 45° 17′; Longitude, 66° 4′.

D. L. Hutchinson, Director.

	Barometer.			Temperature.			Cloudiness: 0 — Clear. 10 — wholly clouded.	Precipitation Rain and Melted Snow.	Wind Direction and Velocity.																		Thunder Storms.
									N.		N. E.		E.		S. E.		S.		S. W.		W.		N. W.				
	Mean.	Highest.	Lowest.	Mean.	Maximum.	Minimum.			Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles	Hours.	Miles.	Hours.	Miles.	Calms	Total Miles.	
January	30.00	30.86	29.11	19.7	32.5	−18.5	5	3.94	65	645	109	1067	12	204	61	1470	25	347	95	1115	154	2026	190	2789	33	9,683	0
February.......	30.03	30.55	29.60	21.6	41.5	— 1.5	5	1.08	64	546	62	745	50	508	28	398	16	126	38	395	62	597	330	4073	32	7,383	0
March....... ...	30.00	30.92	29.10	29.1	46.5	— 8.5	6	5.99	50	338	74	646	59	843	73	902	77	718	62	812	49	510	270	42.6	30	8,480	0
April...........	30.04	30.65	29.48	38.4	62	15.5	7	3.82	50	506	107	1152	50	310	56	404	126	1118	95	1362	102	1826	77	1099	57	7,277	0
May	29.98	30.87	29.69	49.4	64.7	28.5	7	9.95	65	562	140	1438	36	193	78	448	197	1495	64	869	8	45	54	643	10 2	5,628	1
June............	29.91	30.38	29.47	55.6	73.5	42	6	3.76	41	181	100	819	46	269	73	616	146	885	70	1018	28	117	183	1210	83	5,115	4
July..	30.05	30.41	29.68	60.6	78.8	47.8	7	2.78	42	264	62	541	41	253	93	575	310	1823	70	841	1	6	25	237	100	4.540	2
August	29.96	30.13	29.63	61.7	76.5	48	5	3.83	61	357	90	201	45	480	69	538	183	177	128	1395	56	564	67	616	105	5,123	6
September.......	30.01	30.39	29.61	55.1	84.2	26.7	5	1.89	58	328	31	147	47	226	23	90	83	443	116	1221	30	187	241	3586	91	6,171	0
October..........	30.13	30.65	29.42	46.8	68.8	26	4	0.80	69	468	38	281	16	49	32	856	94	817	176	1720	33	236	210	3393	76	7,328	0
November........	29.99	30.70	29.87	35.2	54.5	7.5	7	6.87	30	208	105	808	14	147	58	1091	23	388	111	2.86	26	228	319	5136	34	10,282	0
December........	30.01	30.66	29.20	26.7	53.5	2.5	6	3.56	78	527	27	281	11	57	49	1002	32	542	96	1316	68	544	298	4400	75	8,669	0

Barometer readings are reduced to sea level and 32° Fahr. The – sign indicates temperature below zero. The maximum temperature, 84.2, was registered on the 6th of September; the minimum temperature, −13.5, on the 19th of January.

MEAN SEA LEVEL AT ST. JOHN.

(Abstract of paper by E. T. P. Shewen, C.E.; read March 1st, 1898.)

The determination of mean sea level at St. John furnishes a fixed datum from which to calculate tidal fluctuations, besides elevations for geological, geodetic, and physiographic studies.

Last year this determination was made from an analysis of two years of tidal observations, recorded by the Thomson gauge at Reed's Point, covering the period between April 1894, and May 1896. The gauge is in charge of Mr. D. L. Hutchinson of the St. John Observatory; and the records obtained have been carefully reduced to datum by Mr. W. Bell Dawson, Engineer in charge of the Tidal Survey. The resulting values of mean sea level, and of high and low water, ordinary spring tides, have been referred to a bench mark cut for the purpose on the southeast corner of the Custom House. (See Bull. N. H. S. of N. B., No. XIII, p. 109.)

Mean sea level is 41.65 feet below the bench mark, or 12.67 feet below high water ordinary spring tides, the range being 25.33 feet.

City Levels.—City levels are taken from forty feet below assumed (extreme) high water. The elevation of any point above mean sea level is the reduced level, according to city datum, minus 25.49 feet.

Intercolonial Railway Levels (St. John to Shediac).—The elevation of any point above mean sea level is the reduced level, according to I. C. R. datum, minus 86.95 feet.

EUROPEAN AND NORTH AMERICAN RAILWAY DATUM (NOW I. C. R.)

		Feet.
High water spring tides, St. John (Bay of Fundy)		100.00
Mill street		104.95
The Marsh		102
Lawlor's Lake		162
Rothesay	(9 miles from St. John)	107
Hampton	(22 " " "	117
Sussex	(44 " " "	155.53
Penobsquis	(51 " " "	154
Moncton Station	(89 " " "	136.74
Sackville	(128 " " "	116.25
Shediac Wharf, rail level (Northumberland Strait)		93.30
High water, Shediac (108 miles from St. John)		89.30

A detailed statement of levels from St. John to Shediac is given in Report of the Railway Commissioners of New Brunswick, 1859, pp. 84–88.

Mr. A. L. Light, Chief Engineer of the European & North American Railway, reported, on the 2nd Feb., 1859 : "It will be observed that the level of the rails on Shediac wharf is 6.70 below high water at St. John, and the level of high tide at the latter place is 10.70 feet above that at Shediac Harbour."

On the close of the exploratory survey for the Intercolonial Railway, made in 1864, Sandford Fleming reports that the various levels were found to be relatively as follows :

First Datum.

Restigouche to Green River; then to Toledi and Rimouski waters; thence to River Trois Pistoles; also from the Restigouche to the Tobique; thence to Nashwaak and to Keswick Summit — said to be high water on the Miramichi.................................. 84.81

Second Datum.

From a point five miles up Keswick valley to Keswick Summit; also from the same point past Fredericton to Little River............. 101.81

Third Dntum.

On this datum levels were carried from Little River to Coal Creek..... 58.08

EUROPEAN AND NORTH AMERICAN (NOW I. C. R.) RAILWAY DATUM.

Fourth Datum.

Said to be 100 feet under high water on Bay of Fundy, at St. John City, 0.00

The datum for Nova Scotia is low water at Parrsboro, on the Basin of Minas.

The datum for the Matapedia survey is high water above Campbellton on Bay Chaleur, and on the River St. Lawrence at St. Flavie.

High water, River St. Lawrence, at Trois Pistoles......... .... 70.00

THIRTY-SIXTH ANNUAL REPORT OF THE COUNCIL

OF THE

NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

The Council of the Natural History Society beg leave to submit the following report for the year now ending:

MEMBERSHIP.

A very satisfactory increase has taken place in the membership, to which we note the following additions:

Ordinary	12
Associate	24
Corresponding	1
	37

FINANCE.

The Treasurer makes the following statement:

Receipts.

Balance from 1897	$ 6 44
Membership fees	140 07
Investment, interest on	144 00
Proceeds of lecture by Prof. Bailey	14 50
Bulletins sold	19 90
Dividend from Botsford estate	10 00
Donations	11 00
Government grant	125 00
	$470 91

Expenditures.

Balance on Bulletin XIV	$ 88 75
Printing and distributing Bulletin XV	183 37
Maintenance of Museum	88 60
Expense Camp for field work at Quaco	27 99
Miscellaneous (expressage, labor, postage, etc	50 64
Balance on hand	31 56
	$470 91

Library.

The rapid expansion of the library has necessitated some changes in arranging for space to accommodate the books we now have, and at the same time allow for future additions.

Among important accessions we notice Geological Reports on New Brunswick (complete set), written by Dr. A. Gesner, presented by Henry F. Perley, and the Journal of the Royal Geographical Society, which we obtain in exchange for our bulletin.

Publications.

Bulletin XV was issued in June last. It contains valuable articles by Dr. Geo. F. Matthew, Professor A. Wilmer Duff, and Dr. W. D. Matthew. As this number concludes Volume III, it is furnished with an index.

Bulletin III (1884) has long been out of print, and the Society has been unable to supply copies to numerous applicants. We are glad to be able to announce that, by the enterprise of one of our members, this number has been reprinted without any expense to the Society.

A number of the shorter papers read before the Society have been published in the daily papers.

Lectures and Essays.

Nine regular meetings were held, at which papers were read as follows:

Feb'y 2. Tidal Phenomena of the St. John River at Low Summer Level, by Prof. A. Wilmer Duff. (Pub. in Bulletin XV.)

March 2. Address on Peat-Bogs, by Dr. Geo. F. Matthew.
Note "Upon the Colour of the Waters in New Brunswick Rivers," by Prof. W. F. Ganong.

April 6. Note "Upon the Heights of New Brunswick," by Prof. W. F. Ganong.
Address on the Geological Features of Quaco, by Dr. Geo. F. Matthew.
The Relations of France to Newfoundland, by H. Geo. Addy, M.D.

May 4. Address on "A New Palæozoic Insect, with Notes on the Fauna in which it Occurs," by Dr. Geo. F. Matthew. (Pub. in Bulletin XV.)
"Some Probable Jesuit Influences Upon our North-Eastern Flora," by Prof. M. L. Fernald.

June 1. "The Indian Potato: What was It?" by Rev. W. O. Raymond.
"Trees and Forests," by James Vroom.

Oct. 4. Reports on the work of the Quaco Camp, by President Hay, Dr. Matthew, and Percy G. Hall.

Nov. 2. Address on the History of Rockwood Bog, by Dr. Geo. F. Matthew.

Dec. 7. "Notes on a Wild Garden," by Geo. U. Hay.
Note "Upon the Manner in which the Bay of Fundy Rivers of New Brunswick empty into the Sea," by Prof. W. F. Ganong.

Jan'y 4. "Niagara," by Prof. L. W. Bailey.
Canadian Earthquakes in 1897, by Samuel W. Kain.

In addition to the above, an elementary series of lectures was delivered, viz.:

London Museums; Geology from a Railway Train; Peat-Bogs — three lectures by Dr. Geo. F. Matthew.

* Philosophy of Art — Dr. D. R. Moore.

Upon Trinidad and the Customs of Its People — J. V. Ellis, Jr.

Pre-Historic American Pottery — S. W. Kain.

Anatomical Features of Birds; Plumage of Birds; Observation, Collecting, and Mounting — three lectures by A. Gordon Leavitt.

Invertebrates.

The Chairman of this Committee reports that the entire collection of insects has been re-mounted and re-arranged by Mr. Wm. McIntosh. He has also added some 500 specimens, which, with about 200 specimens presented by Mr. Philip McIntosh and Mrs. S. B. McPherson, constitute the most important accession of the year.

Archæology.

But little work has been done in this department. A circular has been received from Prof. Penhallow asking the co-operation of the Society in a scheme having for its object the collection of information relative to the ethnography of Canada. The Committee hope to aid in this work when definite plans have been arranged by the promoters.

Museum.

The museum has been open to the public, as usual, on Tuesday evenings and Saturday afternoons, and, as the register shows, has attracted many visitors. The rooms underwent a thorough cleaning in October, but constant attention is required to keep them in good condition.

Botany.

The Committee on Botany record a few plants found new to the province. A list of these will be found on page 75.

Geology.

The report of the Chairman of the Geological Committee deals at some length with the work at Quaco (in connection with the Summer Camp), where a third member of the Mesozoic system, the presence of which has not been before noticed, was recognized by Dr. Matthew.

* Published in pamphlet of 28 pp, 1897; reviewed in Pop. Sci. Monthly, Oct., 1897.

General.

A movement, originating, we need scarcely say, in the minds of the Associate Members, is now on foot to open the rooms to the public three afternoons in the week. They propose to employ a lady librarian and curator, who will place and keep the museum in good order, and catalogue and re-arrange the library, under the direction of the regular officers of those departments. The necessary funds will be obtained by enlarging the membership and by special donations.

A programme of the winter's work has been distributed, and exhibits a new departure—that of laboratory work—which we think will prove both interesting and profitable.

We desire to remind you that a building fund has been established by one of our members; and we trust that further donations will soon be forthcoming; for we must remain alive to the fact that the space at our disposal is quite inadequate to our purpose, and that our collections, being unsafely housed, must, in case of fire, be entirely destroyed. Let us hope that our new building is not so very far in the future.

The Summer Camp of July last was, perhaps, the most enjoyable in the history of the Society. The trustees of the St. Martins Seminary very courteously placed their large building at our disposal, and we found ourselves in comfortable quarters, provided with excellent facilities for class-work and lectures, and centrally and pleasantly situated. Amongst those who attended we may mention Prof. L. W. Bailey, Dr. Geo. F. Matthew, President G. U. Hay, Prof. W. F. Ganong, and Prof. A. Wilmer Duff.

To the press of St. John we owe our best thanks for the free publication of notices and reports of meetings, and of articles of much greater length; and also to the gentlemen who contributed to the lectures and essay series during the year.

While on reviewing the past year we do not find so many remarkable features as in its predecessor, yet we feel quite justified in considering it one of more than average excellence. It witnessed a large addition to the membership, a most successful Summer Camp, considerable accession to the museum and library, the issue of a large bulletin, and, finally, the appointment of a permanent assistant librarian and curator. We feel confident that the ensuing year will be equally active and equally prosperous.

Respectfully submitted.

PERCY G. HALL,
Secretary.

REPORT OF THE FREDERICTON NATURAL HISTORY SOCIETY.

(Instituted February 2nd, 1895.)

The Fredericton Natural History Society, of which L. W. Bailey, Ph.D., LL.D., is President, held nine regular meetings during the year ending 20th February, 1898, at which the following papers were read :

1897.

Mar. 15. "The Geology of England from a Railway Train," by Dr. G. F. Matthew.

April 19. "The Body-Covering of Animals," by Dr. L. W. Bailey.

May 17. "The Bony Framework of the Human Body," by H. H. Hagerman, B.A.

May 27. "The Forms, Sizes, and other Characteristics of Flowers," by Prof. W. F. Ganong.

Oct. 18. "Niagara," by Dr. Bailey.

Nov. 22. "The Face of the Earth," by Dr. Bailey.

Dec. 13. "The Botany of the Restigouche," by G. U. Hay, M.A.

1898.

Jan'y 17. "Rocks, and What They Tell Us," by Dr. Bailey.

Feb'y 21. "Rock Ruins," by Dr. Bailey.

Through the efforts of members of the Society, the common schools of the city of Fredericton have been supplied with sets of common minerals for class use, and the High School is being supplied with a collection of the minerals of New Brunswick. Some field work has been done by the members of the Society, but not as much as might be desired. Mr. W. H. Moore, however, one of our ornithologists, has been able to add two birds to the list of summer residents of New Brunswick — the Marsh Wren *(Cistothorus palustris)* and Lincoln's Song Sparrow *(Melosphiza lincolni)*.

JOHN BRITTAIN,
Secretary.

REPORT OF THE KINGS COUNTY NATURAL HISTORY SOCIETY.

Organized October 2nd, 1897, at Sussex, Kings Co., N. B.

OFFICERS.

President—Robert King, A.B., Sussex.
Vice-President—Miss Louise Wetmore, Sussex.
Secretary-Treasurer—Mr. W. N. Biggar, Sussex.
Chairman of Executive Com.—Mr. Wm. Goold, Sussex.

OBJECTS OF THE SOCIETY.

The objects of the Society, as set forth in its Constitution, are as follows :

The study of the natural history of the Province of New Brunswick in general, and especially of Kings County;

The collection and preservation of specimens;

The foundation of a library of scientific books;

The meeting of members at regular periods for mutual instruction in natural science.

MEETINGS, MEMBERSHIP, ETC.

Regular meetings are held at 9.30 a. m. on the first Saturday in each month. The Society, which started with twenty-four charter members, has now fifty-two names on its roll. The increase in membership and interest has been steady, and the results obtained by united endeavor, so far, satisfactory. For convenience in working, the members are divided, according to their own preference, into five sections, as follows : Geology and mineralogy, botany, zoology, ornithology, and entomology. Each of these sections is in charge of a committee of three. The annual membership fee is twenty-five cents, and visitors, invited by members, are welcomed. The election of officers takes place on the Saturday before Labor Day in each year. The thanks of the Society are due the Natural History Society of New Brunswick, and especially to President G. U. Hay for help in organizing, copies of bulletins, and many other favors.

W. N. BIGGAR,
Secretary.

DONATIONS TO THE LIBRARY, 1897.

Donor's Name.	Residence.	Work.
Royal Geographical Society	London	Journal.
Hugh Robert Mill	do	1 Vol., 4 Pamphlets.
Trustees British Museum	do	Guides.
Royal Society	do	Proceedings.
Royal Colonial Institute	do	Journal.
Geological Society	do	Abs. of Proceedings.
Director Royal Gardens	Kew	Bulletins.
Manchester Geological Society	Manchester	Proceed. and Trans.
Biological Society	Liverpool	do
Liverpool Geological Society	do	do
Marine Biological Association	Plymouth	Journal.
Natural History Society	Glasgow	Proceedings.
Mason College	Birmingham	Calendar.
Royal Society of Canada	Ottawa	Proceed. and Trans.
Ottawa Field Naturalists' Club	do	Ottawa Naturalist.
Department Inland Revenue	do	Bulletins.
Department of Agriculture	do	Census Reports.
Experimental Farms	do	Bulletins.
Hon. Geo. E. Foster	do	4 Volumes.
Henry F. Perley	do	Gesner's Reports.
Entomological Society of Ontario	London, Ont.	Can. Entomologist.
Hamilton Association	Hamilton	Journal.
Natural History Society	Montreal	Can. Record of Scien.
Historical and Scientific Society of Manitoba	Winnipeg	Report.
Nova Scotia Institute of Natural Sciences	Halifax	Proceedings.
Canadian Institute	Toronto	Transactions.
Toronto Public Library	do	Report.
Astronomical and Physical Society	do	Transactions.
R. F Stupart	do	Weather Review.
Government of British Columbia	Victoria	Mining Record.
Natural History Society of British Columbia	do	Bulletin 2.
Dr. Geo. F. Matthew	St. John, N. B.	Pamphlets.
Dr. W. D Matthew	do	do
Thomas Cunard	do	8 Volumes.
D. Russell Jack	do	30 do
Mrs. Gilbert Murdock	do	Water Rep, 1854-94.
Samuel W. Kain	do	Gray's Botany.
New Brunswick Historical Society	do	Collections.
Scientific Association of Trinidad	Port of Spain	Proceedings.
Australian Museum	Sydney, N.S.W.	Report.
Australian Association for Advancement of Science	do	Report, Vol. VI.
Linnæan Society of N. S. W.	Elizabeth Bay.	Proceedings.
New Zealand Institute	Wellington, N.Z	Proceed. and Trans.
U. S. Bureau of Ethnology	Washington	Reports.
U. S. Geological Survey	do	Reports and Bulletins
U. S. Fish Commission	do	do
U S. National Museum	do	Reports and Proc.
U. S. Department of Agriculture (Botanical Division)	do	Bulletins.
U. S. Coast and Geodetic Survey	do	Report.
U. S. Weather Bureau	do	Weather Review.
Smithsonian Institution	do	Report.
University of California	Berkeley, Cal.	Bulletins.
University of Michigan	Ann Arbor	Report.
Cornell University	Ithaca, N. Y.	Bulletins.
Tufts' College	Tufts'Col. Mass	Studies.
John Hopkins University	Baltimore	Circulars.
Amherst College	Massachusetts	Calendar.
Leland Stanford, Jr., University	Palo Alto, Cal.	Proceedings.
Boston Society of Natural History	Boston	Proceedings.
Boston Public Library	do	Report.
Essex Institute	Salem	Transactions.
New York Academy of Sciences	New York	Journal.
New York Microscopical Society	do	Abstract of Proc.
Linnæn Society of New York	do	Report.
American Museum of Natural History	do	Bulletin.

DONATIONS TO THE LIBRARY—(*Continued*).

DONOR'S NAME.	RESIDENCE.	WORK.
New York Public Library	New York	Bulletins.
University of New York	Albany	Museum Report.
Colgate University	Hamilton	Circulars.
Natural Science Association of Staten Island	New Brighton	Proceedings.
Rochester Academy of Natural Sciences	Rochester, N.Y	do
Iowa Academy of Sciences	DesMoines	do
Academy of Natural Science	Philadelphia	do
Minnesota Academy of Natural Sciences	Minneapolis	Bulletins.
Texas Academy of Science	Austin	Transactions.
Indiana Academy of Natural Sciences	Indianapolis	Proceedings.
California Academy of Sciences	San Francisco	do
Colorado Scientific Society	Denver	Transactions.
C. G. Lloyd	Cincinnati	Plates.
Missouri Botanical Gardens	St. Louis	Report.
Field Columbian Museum	Chicago	Publications.
Societe Scientifique du Chili	Santiago	Actes.
National Museum	Montevideo	Annales.
Royal Academy of Science	Stockholm	Proceedings.
Comite Geologique du Russie	St. Petersburg	Memoirs.
Imperial Academy of Sciences	do	Bulletins.

DONATIONS TO THE MUSEUM.

DATE.	DONOR'S NAME AND DESCRIPTION OF ARTICLE.
1897.	
Feb.	MR. E. J. ARMSTRONG. Specimen of Asbestos.
	MR. L. L. CASSIDY. Specimens of Gold, Silver, and Copper Ores.
Mar.	MR. G. S. FISHER. Specimens of Wood gnawed by Beavers, from Rockwood Bog.
	MR. W. A. JACK. Tadpoles and small Fishes.
Apr.	MRS. GILBERT MURDOCK. Cup and Saucer, manufactured in 15th century. Fire Bucket, Two Vases, One Dollar Bill and one Quarter Dollar, which went through St. John fire of June 20, 1877.
	MR. A. GORDON LEAVITT. Harlequin Duck (mounted).
May.	GEN. D. B. WARNER. Honeycomb in spruce tree, on stand.
	MR. W. F. BEST. Star-fishes and Sea-urchins from Partridge Island.

DONATIONS TO THE MUSEUM—(*Continued*).

DATE.	DONOR'S NAME AND DESCRIPTION OF ARTICLE.
1897. *May*	MR. JOS. ALLISON. Curious section of Wood.
	MR. NORMAN ROBERTSON. Mineral specimens from Kootenay, B. C.
Oct.	MR. W. A. BUTLER. Calamites approximates.
	MR. ROBERT THOMSON. Ammonite imbedded in flint pebble; also minerals from Giant's Causeway, Ireland.
	MR. F. J. MCNAUGHTON, Fossil Footprints of reptile from Joggins, N. S.
Nov	DR. GEO. F. MATTHEW. Section of Rockwood Bog, and section of large cedar tree.
Dec.	MR. WM. MCINTOSH, PHILIP MCINTOSH, and MRS. S. B. MCPHERSON. Collection of Native Insects, 534 specimens.
	MR. JOSHUA P. CLAYTON. Pair of child's clogs from Bury, Lancashire, G. B. Chart of St. John Harbor, dated September, 1761.

DONATIONS TO THE FUNDS, 1897.

A. Gordon Leavitt, Esq. (to Building Fund).......	$10.00
Anonymous..................................	1.00
	$11.00

Officers and Committees of the Natural History Society for 1898.

Patron—His Honor the Lieutenant Governor, Honorable A. R. McClelan.

Council for 1898.

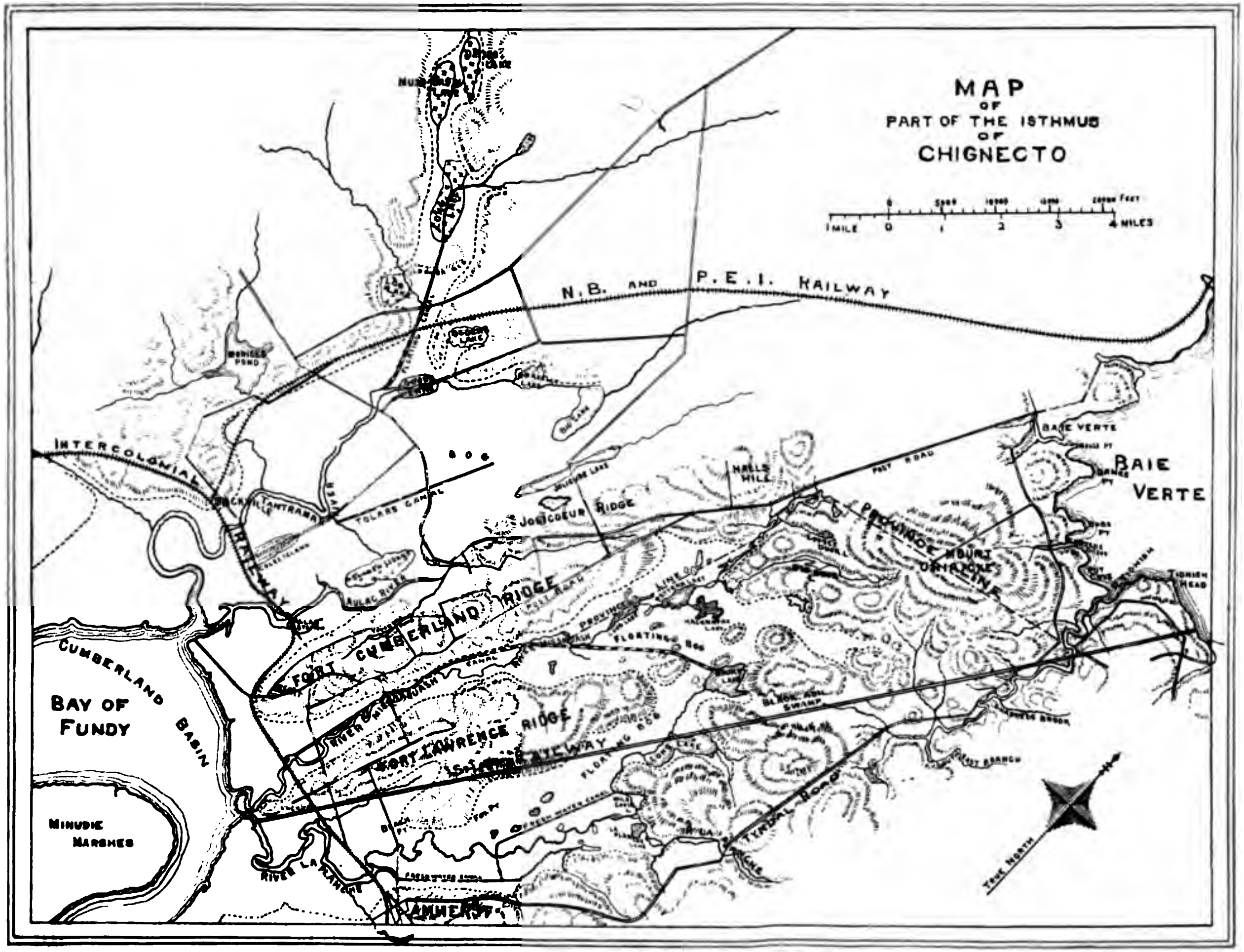
President—Geo. U. Hay, M.A., F.R.S.C.
Vice-Presidents—H. George Addy, M.D.; William Murdoch, C.E.
Treasurer—Robert Matthew, Esq.
Secretary—Percy G. Hall, Esq.
Librarian—Samuel W. Kain, Esq.
Curators—Dr. Geo. F. Matthew, A. Gordon Leavitt, and William McIntosh.
Additional Members—J. Roy Campbell, W. Frank Hatheway, Frank E. Holman.
Delegate to the Royal Society—William J. Wilson.
Assistant Librarian and Curator—Miss Edith McBeath.

Associate Members' Branch.

President—Mrs. Geo. F. Matthew.
Secretary-Treasurer—Mrs. Frank E. Holman.

Standing Committees for 1898.

Physics—Wm. Murdoch, Prof. A. Wilmer Duff, E. T. P. Shewen, C.E.
Geology—Dr. G. F. Matthew, Prof. L. W. Bailey, Geo. J. Trueman.
Ornithology—A. Gordon Leavitt, A. Morrisey.
Botany—Geo. U. Hay, Mrs. Wm. Bowden, Jas. Vroom, Mrs. H. Geo. Addy, Wm. McIntosh.
Archæology—S. W. Kain, F. E. Holman, R. Matthew.
Library—S. W. Kain, Mrs. Geo. U. Hay, R. Matthew, Mrs. W. F. Hatheway.
Rooms—Dr. H. Geo. Addy, Miss K. A. M. Cotter, Mrs. Geo. U. Hay, J. E. Wilson, Wm. McIntosh, Mrs. F. E. Holman.
Finance—R. Matthew, J. Roy Campbell, W. F. Hatheway.
Press—S. W. Kain, A. Gordon Leavitt, P. G. Hall, Miss Dorothea Matthew, Miss Edith McBeath.
Lectures—Geo. U. Hay, Miss A. Jack, Dr. H. Geo. Addy, S. W. Kain, P. G. Hall.
Publications—Dr. G. F. Matthew, S. W. Kain, Geo. U. Hay, P. G. Hall, A. Gordon Leavitt.
Microscopes—Dr. W. W. White, Wm. McIntosh, Chas. F. B. Rowe.


MAP
OF
PART OF THE ISTHMUS
OF
CHIGNECTO
1 MILE 0 1 2 3 4 MILES
N.B. AND P.E.I. RAILWAY
INTERCOLONIAL
RAILWAY
TANTRAMAR
TOLARS CANAL
BOG
JOLICOEUR RIDGE
HALLS HILL
POST ROAD
BAIE VERTE
BAIE
VERTE
MOUNT WHATELY
CUMBERLAND RIDGE
FORT CUMBERLAND
BAY OF
FUNDY
CUMBERLAND BASIN
MINUDIE
MARSHES
FORT LAWRENCE
RIDGE
RIVER LA PLANCHE
AMHERST
FLOATING BOG
BLACK ROCK SWAMP
TYNDAL ROAD
TRUE NORTH
TIDNISH HEAD
AULAC RIVER
BIG LAKE
NUMBER ONE LAKE
DODGE'S POND

BULLETIN

OF THE

NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

No. XVII.

(Volume IV. Part II.)

PUBLISHED BY THE SOCIETY.

SAINT JOHN, N. B., CANADA:
Barnes & Co., Printers, 84 Prince William Street,
1899.

BULLETIN

OF THE

NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

ARTICLE I.

THE MARSH AND LAKE REGION AT THE HEAD OF CHIGNECTO BAY.

BY GEORGE J. TRUEMAN, M. A.

Read April 2, 1896.

CONTENTS.

Geographical Description.—The Isthmus of Chignecto is about fifteen miles wide at its narrowest part. Its western shore is washed by the head waters of the Bay of Fundy. This Bay, running up toward the north-east, tapers into Chignecto Bay, which divides into Shepody Bay on the north and into Cumberland Basin, between Cumberland in Nova Scotia and Westmorland in New Brunswick. These two arms of Chignecto Bay are separated by a somewhat boot-shaped piece of land, known as the Meranguin Peninsula.

Shepody Bay receives the waters of the Petitcodiac and Memramcook, while the Tantramar, Aulac, Missiguash, La Planche and River Hebert, with the Nappan and Maccan Rivers, flow into Cumberland Basin.

All these streams have areas of marsh or bog lands along the greater part of their courses. The largest bodies now in cultivation are along the Tantramar, the most northerly of the group. The relative position of the rivers can be best seen from the accompanying map, but a few words of description are necessary for those who are not familiar with the country.

The Tantramar and Aulac flow into the Basin by one mouth. Some three miles up the Tantramar is the village of Sackville. The river, with its numerous windings is about twenty miles long. Some eight miles from the mouth the stream divides, one branch coming from Cookville on the north, and the other flowing down the marsh from the north-east.

The Aulac is not separated from the Tantramar by a ridge of highland, as is usually the case with the marsh rivers. About five miles from the mouth, the Aulac branches, one branch, La Coup, flowing down from the Jolicure Lakes to the north of Jolicure, the other branch coming down between Jolicure Point and the Aulac ridge.

The Missiguash River flows almost parallel with the Aulac, from which it is separated by a high ridge of millstone grit, called the Aulac or Point de Bute Ridge. This river is not more than twelve miles long, and the upper part of its course is lost in a maze of lakes and bog. Along its lower course it forms the boundary between the two provinces, New Brunswick and Nova Scotia.

At the same mouth by which the Missiguash enters the Basin, the La Planche finds its way to the sea. The lower courses of the rivers are separated by Fort Lawrence Ridge. This ridge is not so high as that on the north of the Missiguash, and it is overlaid with Permo-Carboniferous rocks. The lakes and bogs of these two streams unite at their sources. The town of Amherst is south-east of the mouth of the La Planche, beyond this the Basin takes a sudden turn to the south, and terminates in the mouth of the River Hebert.

Surface Geology.—The Isthmus is overlaid with Permo-Carboniferous rocks, with the exception of the Aulac Ridge with its continuation across the mouth of the Aulac and the Tantramar to Westcock. This strip is Millstone Grit.

The marsh mud is from one to one hundred and fifty feet deep, and is underlaid with Permo-Carboniferous shales and sandstones. These shales are covered in many places with heavy red clay similar to that found on the Aulac and Fort Lawrence ridges. The marsh

mud and underlying soil are perfectly distinct, and there is every evidence that the mud has been laid down in recent geological times; certainly since the Glacial period. Off Fowler's Hill, on the Aulac Ridge, the descent is very rapid, and one-third of a mile from the shore borings have shown the mud to be one hundred and fifty feet thick. At the same distance from the Sackville shore, where the hills slope more gradually, there is not more than sixty feet of mud.

Formation of the Marsh.—As to how this marsh was formed one not thoroughly conversant with the geology of the region can do little else than speculate. There have evidently been many changes in the level of the southern shore of New Brunswick in known geological times. Dr. G. F. Matthew considers that the Isthmus was far above its present level in the Glacial period. At that time Chignecto Bay would be a valley and the Bay of Fundy dry land. Glacial action would have eroded the surface and moved the loose incoherent material to lower levels. The depression of the land that followed the glacial period would have allowed the accumulation of marine clays such as are now found on the Aulac Ridge and adjoining elevations. A subsequent re-elevation would permit the accumulation of forest mould and soil on these ridges and the contiguous valleys.

In 1892, when excavations for the marine dock were being made near the mouth of the Missiguash River, numerous trunks of trees were found about at low tide level. Sir Wm. Dawson, some years ago, found a stump there showing over one hundred rings of growth. (Acadian Geol. p. 28-29). Some of these trees were white pine, others beech; neither variety attain such a size on damp land. Evidently the land where these trees were growing was much above its present level. The trees were found rooted in a rich loamy soil resting on a bed of red clay. To be above the reach of high tides the region would have to be from sixty to eighty feet above the present level.

On the Baie Verte side of the Isthmus abundant evidence is found of recent depression. Mr. E. P. Goodwin, C. E., of Baie Verte, while digging mud for fertilizing purposes, found oak leaves and spruce cones in the solid mud twelve feet below the surface, and there was every evidence that they had fallen on what was then the ground surface.

The subsidence was probably gradual, and on the Bay of Fundy has practically ceased, as the dykes have not been made perceptibly higher in the last 100 years.

When the regions first settled below high tide level, the salt water would creep around the sturdy beeches and pines, and while depositing the food for plants yet to grow, would kill off the old and hardy race of trees. Ice would break off the tops of these trees, and the water bear them away, or the elements would rot the tops down, and only the lower part, encased in the solid mud, would remain to tell the story of the old upland valleys now under the marsh. The land nearest the Basin would at first be submerged, but as the depression went on the salt water would make its way further and further up the valleys. It would seem from an examination of these regions that neither moss nor grass made any perceptible growth until the subsidence ceased. At points down the Bay there is evidence of different surface soils of the marsh that were formed in the process of settlement. On Cobequid Bay near Onslow several turfs are plainly seen, each separated by a foot or more of deposited mud. A canal, fifteen feet deep at the mouth with a grade of two feet to the mile, is now being dug up the Point de Bute marsh, and in no place throughout the three miles already dug is there any evidence of vegetable remains below the present surface. In the marsh soil vegetable remains would be very readily detected by the presence of the surrounding blue mud. The same absence of blue turf or peaty surfaces is seen wherever canals have been dug in the marsh soil.

The marsh rivers are constantly changing their beds. After the depression first occurred they may have kept their channels for some time, but by the rush of mud-laden water every curve becomes greater; as the stream rushes against the opposite bank one side wears off and the other builds on.

In the memory of men now living, marked changed have been made in the position and direction of some of the rivers. Off Prospect Farm at Point de Bute, the Aulac has, in the last two hundred years moved some three hundred feet nearer to Sunken Island. This change is clearly proven by the old dykes. When it is remembered that the Aulac has been abandoned for sixty years, it will be seen how rapidly these changes are made.

Marsh Improvements—Nature did much to make this a fertile region, but it was necessary for man to make some exertion that he might reap the harvest. The French, settling here in the seventeenth century, dyked the rivers and raised crops on the marshes. There are records of their damming up the smaller streams in the first half of

the eighteenth century. Father LaLoutre used the men and money for this purpose that were sent him to be used in putting Fort Beausejour in a state of defense, but not until the English came to this country were large aboideaus built.

In 1827 the Aulac was aboideaued four miles from its mouth, and in 1840 an aboideau was thrown across less than two miles further down.

Eighty years ago these lands presented a very different appearance from what they do now. The Aulac was much larger, at least in its upper course, than the Tantramar. The bridge across the Tantramar, where the upper bridge now stands, was just eighteen feet wide, as stated in an old contract. Above this point the whole region was covered with moss, and the water oozed rather than flowed into a very crooked, lazy stream. A mile north-east of the bridge, in the bog, Goose Lake was situated. Its waters flowed north-east to Gravelly-beach Lake, and then in about the same course to Big Lake. Big Lake drained into the Aulac through La Coup. A large part of the land in the lower course of the rivers was also bog.

About 1815 Tolar Thompson started a canal between the Tantramar and Goose Lake. This man, a farmer, had made a careful study of the lake region, and was convinced that the lakes could be drained and made into marsh. Before this canal was finished in 1820, one was dug in a northerly direction toward Log Lake. The old river course and the canals can be seen on the accompanying map. The new canal took a straight course. Tolar's Island and the old river bed with its many curves, filled up level with Bay of Fundy mud. This canal was cut through about ten feet of moss, but did not go into the underlying mud. The moss was cut in large junks and floated down the stream by the receding tide, hence the name "Floating Canal" which it still bears.

In recent years, this canal has been extended five miles beyond the Upper Bridge, and hundreds of acres of good marsh are to be seen in the place of lake and moss. The lakes were from four to seven feet deep, and they were allowed to fill with mud before the surrounding moss was covered with the deposit. Several small lakes on this branch are still unreclaimed, but they are gradually filling with the mud from the canal. Blue or red mud underlies all the lake and bog areas, and is found in the valley eight or ten miles above the upper bridge. The greater part of the low moss has been made up, but hundreds of acres of high moss are still growing "hard hacks" and small trees.

The floating canal has greatly increased in size since it was dug and has worn into the mud from two to four feet. On the more southerly branch of the Tantramar, at Goose Lake, hay has been cut for seventy years. Moss is again growing on this lake and surrounding lands, and large tracts are having their fertility ruined. The more energetic farmers are digging wide ditches and using the rich marsh soil thus obtained as a fertilizer. Good results are in this way secured.

The Aulac river has not been so well handled. The Trueman and Etter aboideaus have much reduced the size of the river. The system of lakes at the head of LaCoup stream is shut off from the tide. The rail and carriage roads cross the river on the Etter Aboideau. Only at a great cost could the river be again opened and the natural fertilizers carried to the Point de Bute marshes. Not only this, but some of the lakes on La Coup have been turned down the Tantramar, and even were the stream opened, the basin above into which it might throw its waters would be much reduced.

Formation of Lake and Bog.—One naturally wonders how all these lakes were formed, and what led to the tremendous growth of moss. The building up of the lakes has given a clue to their formation. When the water is first let into a lake the greatest depth of mud is deposited at its mouth. where the tidal waters enter. If the season is rainy the outflowing fresh water may prevent any deposit, but if the time is dry eighteen inches of mud may be laid down at a lake entrance in a single set of spring tides. The reason for this is evident. The water, running up the canal with great force, loses its speed as it spreads over the lake, and the larger part of the sediment settles at once. As the water runs slowly up the river in the neap tides, much sediment is deposited in the river bed. When the spring tides come on, especially those in the late summer when it is usually dry, this sediment is lifted and carried into the lakes above. Thus the water at the head of the stream is often more heavily laden with mud than that further down.

Red or blue mud underlies both lake and bog, its depth varying as the underlying soil rises or falls. Under the whole upper section the mud is about the same level. Owing to the gathering of silt the lake bottoms are often higher than the mud below the surrounding bog. Evidently the tide once flowed through the whole valley without being hampered by lake or bog. Before the marsh reached its present state of depression, lake basins were formed by the water damming itself in

as before explained. These lakes and ponds may have been many times drained by the water breaking out in a weaker place. The same thing now takes place in draining the lakes. After the tide has entered, unless the self-erected barrier is dug through, the receding tide, swelled by the fresh water coming down will break out of the lake at some weaker point, and find its way to the river by the path that offers least resistance.

A lake basin once strongly formed would be made stronger by each tide. As the moss gradually settled the barrier would become higher and the lake deeper. One would expect a heavy flow of fresh water to keep the barrier worn down, therefore the largest lakes should be where there is the least flow of fresh water. This is just what is found. Sunken Island, one of the largest lakes, has no stream of any size flowing into it. At the head of Morice's Mill Pond, Sackville, before the dam was put in, there was a small lake reaching from W. W. Fawcett's to the mouth of Beech Hill Stream. Mud extends all over the pond bottom and up the stream to the foot of Beech Hill. The lake is dammed off with marsh mud. The history is evident. The mud has shut off the lake as before described, and the rush of fresh water down Beech Hill Stream has kept the stream open below. When the subsidence of the marsh areas become almost *nil* the lands that had kept their drainage open in course of time became covered with salt grasses. The growth of these grasses had been largely checked by the salt water, while the marsh was settling. Now only the highest tides would cover the drained marsh, and the lakes would be practically freed from any incursions of salt water. Moss then sprang up around these fresh water lakes. Year after year this moss reached out and grew higher. Most of these moss plants are of the genus Sphagnum, and growing one upon another they kept above the level of the water, and grew out over it. This moss was always full of water and exposed such a breadth of surface to the air that the greater part of the water was carried off by evaporation. The moss itself, at least in the older lakes, formed an additional barrier against the tide. In digging the Floating Canal many trees of small size were found buried in the moss. When once started the moss grows over a lake very rapidly. Many of the lakes on the Tantramar have become markedly smaller in the memory of men now living.

Sunken Island is a great lake overgrown with moss, and in this moss are heaths, etc., and stunted trees. Many of these trees are from 15 to 25 feet high, 10 inches in diameter, and show 60 or more

rings of growth. Few of the lake bogs have such large trees on them, and few have become so filled with moss. There is every evidence that this lake was one of the earliest to be dammed off. In the first place it is several miles nearer the mouth of the river than the other lakes, and its position between the Aulac and Tantramar would make it liable to damming from both sides. The small amount of fresh water running out of it would make this easily possible. One or two small open lakes of less than an acre in extent alone remain of the original lake which probably covered nearly one thousand acres. There are about seven feet of water in these lakes, and the depth is about as great close to the shore as farther out. The moss projects over the water in such a manner as to make it dangerous to approach the margin. When examined last by the writer there were several large pieces of detached moss floating in the centre. The moss is now intergrown with heaths, bullrushes, coarse grass, cranberry vines, pitcher plants, etc., so that the "hackmatacks" (larches) find a fair amount of soil in the rotting vegetable matter.

A good deal of money has been spent in Sunken Island with little or no results. The moss is so high that a great deal of salt water will be needed to kill it, and a long time will pass before it will be properly settled. In fact since the aboideaus were blown out and the tide allowed to flow in unhindered on the "Big Marsh," the water has not risen high enough to enter this island at all.

The digging of a canal into the Jolicure Lakes has been agitated for some time. The owners of the Sunken Island body hope the route selected may be through the island. Should the canal take that course the bog could be made into marsh, and probably pay a dividend to the investors.

North-east of Cole's Island the Tantramar curves out, then doubles back on itself, leaving a point of land joined to the mainland by a narrow neck sixty feet wide. High tides swept over this and rendered the point unfit for cultivation. The water going up the river kept its old bed, but no sooner would it get around to the upper side of the neck than it would rush back over the neck to return again by the way of the main river. This gives one an idea of the rapidity with which the water rises as it runs up the river. This neck was cut off in 1893 by two of Sackville's enterprising farmers, and in 1894 there were twenty feet of mud deposited in the old channel. Several acres of marsh will be made from the reclaimed point and the old river bed.

If a canal were cut through the Ram-pasture neck, a similar curve further down, a much larger piece of marsh would be given to the country. Unfortunately the wharves are situated on the curve, and such a change would necessitate their being moved to another part of the river. So great is the rush of water back over this neck when the tide is flowing in, that several hundreds of dollars have been spent by the government to prevent the neck from wearing out of itself.

The work that has been done in building up the marsh soil is but small in comparison with what can be done. At the head of the Missiguash and La Planche rivers the lake and bog areas are extensive. With proper handling, thousands of acres of marsh can be made. The work is being agitated, but the large immediate outlay required, and the prospect of slow returns, deter capitalists from hastening into what at first sight appears to be a fine investment.

Since writing the above paragraph a company has been formed for the purpose of draining the areas at the sources of these rivers. They have had a surveyor on the ground for the past year, and at present have dug two miles in a canal intended to tap all the lakes on the marsh. At present a steam dredge is working about five miles above the mouth of the Missiguash. They began to dig three miles from the mouth, and have made a canal fifteen feet deep by thirty wide, decreasing in depth at the rate of two feet per mile as it approaches the lakes. At Round Lake, which is six miles above the mouth of the canal it should be six feet deep. A number of smaller lakes will be drained before Goose Lake at the head of the marsh is reached. In all there are about ten thousand acres at the head of the two rivers. Near the mouths of these rivers there are already valuable marsh areas. Surveys made in connection with the projected ship canal and marine road, have given abundant material in regard to levels, etc., on this bog. From a study of the levels used by the Missiguash Marsh Company the following data have been obtained: Taking a line one hundred feet below the Saxby tide as a basis, the ground surface at the mouth of the Missiguash is ninety-two feet above datum. The bog surface ten miles up the marsh at Round Lake is ninety-five feet above datum. The average spring tide is ninety-six feet above, while the Saxby tide was one hundred feet above. As the bottom of the lakes is scarcely ninety feet above datum, there will be a good fall from a high tide in the river into the lakes; these should therefore fill with mud and come quickly into grass. The bog begins about six miles from the mouth of the river, and the whole area above that is floating

bog and lake. That the bog is actually floating on mud and water, there can be no doubt. There are from two to three feet of moss and below that as much more rotted moss and water, forming a semi-fluid substance. It does not seem possible that the lakes are held in by this moss; on the other hand the water in places run under the moss, and acts in some ways as a lake with a thin layer of ice on its surface.

E. P. Goodwin, C. E., who has been engineer for the company for the last year, thinks that this moss can be cut in large squares and floated out the canal when the barrier of mud is cut away. It would seem as if the canal being dug is too small when the very slight fall is considered, and the area of the submerged lands.

Borings are to be made this winter all over the bog by Mr. Goodwin, and in the spring new light may be thrown on the history of these regions. So far the canal has not cut through to the bottom of the marsh mud in one instance, nor has it come in contact with one stick or other sign of vegetable remains.

The Marsh Soil.—The sediment floated up by the water is formed from the wearing away of carboniferous sandstone and shales. As the water is comparatively clear at the entrance to Cumberland Basin, the rocks which yield the deposit must be situated above this. At South Joggins nearly two feet of rock are worn away each year, and no doubt the wash is carried up the bay to make marsh soil.

The mud is of an exceedingly fine texture. While very little grit can be detected by the fingers or teeth, it nevertheless contains a large amount of sand as seen in an analysis. Tools that are used in working it soon become blunted. A heavy bolt was worn through on the steam dredge in a few weeks from friction with the soil in shovelling. When wet it seems almost soluble, and is very sticky. After being quickly dried by the sun a harrow has little effect on marsh mud, it being almost as hard as brick. In many cases seed is thrown on the plowed land and the rain causing the soil to run buries it with little or no harrowing.

The marsh soil is naturally of a red color, and this red soil constitutes the valuable marsh. Hay has been cut from this for 100 years and more without materially impairing its fruitfulness. Large quantities of red mud are annually carted on the highlands, and, as a fertilizer, for many soils it is considered equal to barnyard manure. No analysis that has yet been made will explain its marvellous fertility. Sir Wm. Dawson (Acad. Geol. p. 23) thinks it may in a part be due to the presence of fish bones and vegetable remains which do not appear in

an analysis. This seems very doubtful. May one cause not be the extreme fineness of the soil which enables the plant to get its food readily? One reason that so much land is not fertile is that the necessary ingredients are not in a state available for plant food. This soil is in such a fine state of division that it must present a great deal of surface to any dissolving agent. That it is rich there is no doubt, as land that has been cutting heavy crops of hay for nearly two centuries will give a rank growth of timothy when turned up by the plow, and that without one bit of fertilizer during all this time.

Fertility is only insured by a thorough system of drainage. If allowed to lie in the water the red soil changes to blue, and the growth of moss and coarse grasses gives the soil a corky texture. The blue mud covers all the low marshes, but usually has red mud under it at no great depth. This quality of marsh is much less valuable than the red, as it will produce coarse grasses and sedges only. When plowed and drained a good crop of oats can be obtained, but even the native grasses refuse to grow the following year.

This change from red to blue is an interesting one. The red mud derives its color from peroxide of iron In the blue mud the iron is in a state of a sulphuret. The change is brought about by the decay of vegetable matter. The salt water contains salts of lime and magnesia. The vegetable matter excluded from the air unites with these two sulphates of lime and magnesia, liberating the sulphur as hydric sulphide and retaining the oxygen. The sulphide can be detected on any low marsh by means of its unpleasant odor. This gas now unites with the oxide of iron in the mud, producing iron sulphide which gives the marsh its blue or gray color. When the water is drained off, the iron of sulphide unites with the oxygen of the air, forming iron sulphate, a substance poisonous to most crops. This shows why blue mud when drained refuses to grow even the native grasses. When heated the iron sulphate is changed to a brown powder, an oxide of iron similar to the ore, limonite. It is this oxide hydrated that is seen in the bottom and sides of so many marsh ditches. (Acad. Geol.)

Analyses of several Bay of Fundy marsh soils made at the Central Experimental Farm, are given below for the sake of comparison :—

Unclaimed Marsh near Amherst, 1897—

Moisture	3.78
Organic and Volatile	5.86
Coarse Sand	16.60
Fine Sand and Clay	58.73
Nitrogen	.137

Sackville Marsh, 1897—

Potash	.16
Phosphoric Acid	.16
Nitrogen	.131
Lime	.13
Loss on Ignition	5.83

Unclaimed Marsh at Quaco, 1897—

Air dried sample.

Moisture	7.66
Organic and Volatile	7.61
Insoluble Mineral Matter, Sand and Clay	71.96
Mineral Matter soluble in acid	12.77
Lime	.42
Nitrogen	.24
Common Salt	1.4

Mud from Five Islands, N. S.—

Nitrogen	.079
Organic and Volatile	5.23
Sand and Clay	76.73
Mineral Matter soluble in acid	15.9
Water	2.85

Gaspereau River, N. S.

Nitrogen	.084
Water	11.11
Clay and Sand	74.28
Organic Matter	3.35
Oxide of Iron and Al	8.06
Lime	.54
Potash	.40
Phosphoric Acid	.12

ARTICLE II.

THE "DIP" OF THE MAGNETIC NEEDLE IN NEW BRUNSWICK.

BY PROF. A. WILMER DUFF.

Read December 6, 1896.

Nearly everyone knows the use of a magnetic needle for finding the direction of North. Those who are more familiar with the use of such a compass know that the needle does not point to the true North, but only approximately so; that, in fact, the difference between the true North, and the magnetic north as indicated by the compass, differs by an angle which surveyors call the "variation" of the needle. The angle is different at different places, and even at any one place it is always gradually changing, although the change is a very slow one and requires months to be perceptible, unless the measurements be made with very great accuracy.

A casual glance at a compass needle is sufficient to show anyone that the needle is only free to swing in a horizontal plane, owing to the fact that the point of support of the needle is higher than its centre of gravity. Now what would happen if the needle was supported so exactly at its centre of gravity that it could swing in a vertical plane as well as in a horizontal plane? It would be found to come to rest at an inclination to the horizontal. The angle it would then make with the horizontal is called the "dip" of the magnetic needle, or, briefly, "the magnetic dip." The dip, like the variation, is different at different places, and if measured some months apart at any one place it would be found to have changed appreciably.

The importance of the "variation" is so great in surveying and navigation that it is frequently determined, and is pretty closely known by any one who is in the habit of using the compass professionally; but, so far as I am aware, the "dip" has not been accurately determined anywhere in New Brunswick. If, however, I am mistaken, any member of the Natural History Society who can find the record of any past determinations of the dip, will find it interesting to compare those determinations with the readings recorded in the remainder of this paper and note the change time has produced. Before giving the readings I have made, it may be noted that, while observations of the dip have, at the present time, no direct practical importance, they are of interest in assisting toward the formation of a true theory of the nature and cause of the earth's magnetism. Moreover, very remarkable differences, in both dip and variation, within the range of a very few miles have been discovered in several countries, especially in Russia, but also in France and England, and these have attracted great interest as shedding some light on the constitution of parts of the earth situated too far below the surface for direct examination. Whether similar anomalous areas occur in New Brunswick must at present be a matter of mere conjecture; but their discovery, if existant, would be a matter of considerable scientific interest. While the few determinations I have made are insufficient to shed any light on such questions as the above, they will yet be of some interest to anyone who may happen to repeat them a few years hence at the same places.

The following observations were made with a very accurate portable dipping needle, made by Elliott Brothers, of London. It is the property of Purdue University, and was brought east by me during a summer holiday in 1898. A minute description of the instrument, and the method of using it, is not called for here, further than the statement that it was provided with means for careful levelling, reversing the magnetism of the needle, and eliminating the effects of lack of symmetry in the needle or exactness in position of support. Each reading given below is the mean of eight separate readings; and the angles, given in degrees and minutes, are the angles between a horizontal line and the dipping needle, the north pole of the needle dipping downward. Thus, it will be observed, that the needle pointed more nearly vertically than horizontally. Many more observations were made than those recorded below, but they were in the neighbor-

hood of the places mentioned, and (with one doubtful exception, which I hope to examine hereafter) showed no marked local peculiarities.

STATION OF OBSERVATION.	DIP. in August 1898.
St. John (Fort Howe)	74° 35′
St. Andrews	74° 57′
Oak Point (St. John River)	75° 3′
The Point (Bellisle Bay)	75° 15′
Fredericton	75° 44′
Indian Village (above Fredericton)	75° 50′

Thus, in general, the dip increases as we go north, the change between St. John and Fredericton being somewhat over a degree.

I may add, that in addition to the variation and the dip, a third quantity has to be measured, if we wish a complete account of the magnetic condition at any point. This is the strength of the magnetic force at the point; but its measurement involves the use of a very elaborate, heavy and expensive set of apparatus, called a Kew Magnetometer, and this, together with the care and experience required for its use, accounts for no determination having hitherto been made in New Brunswick (or probably the neighboring provinces).

ARTICLE III.

NOTES OF A WILD GARDEN.

BY G. U. HAY.

(Read before the Society, December 7th, 1897.)

About ten years ago the idea occurred to me of planting a wild garden in which should be shown, as far as the conditions would warrant, the peculiarities and extent of the flora of New Brunswick. The garden plot covers an extent of nearly two acres and is well adapted for the purpose intended. It is situated about eleven miles from the city, on a broken piece of ground overlooking the St. John river. In one corner is a meadow, made up of alluvial deposit brought from the neighboring hills, and adapted for plants usually found on intervales. Through this meadow flows a small stream fed by springs on the hills which lie to the westward. The idea of planting a native arboretum was first suggested by finding in this meadow a group of small trees and shrubs eight in number, forming a pretty little arbor on the bank of the curving stream. The plants consisted of the cedar, the white and yellow birch, American ash or rowan-tree, water alder, mountain maple, balsam fir and black spruce. One could stand in the centre of this arbor and touch one-tenth of all our forest trees and shrubs. When nature had made such a beginning it was surely a broad hint for me to do the rest.

When the remainder of the two acre plot came to be explored, possibilities were found to exist for something more than an arboretum; and the idea of a wild garden gradually came, which might include most of our flowering plants, all our native ferns, and perhaps in time a representative gathering of our mosses, lichens and fungi. Rising from the meadow toward the south, within the bounds of the plot, is a hill whose slope is covered with a young but quite ample growth of spruce, fir, birch, maple, etc., the deciduous trees largely prevailing, and giving to the soil each year an abundant supply of leaf mould. Half way up this hill, in the centre of the grove, is a depression which

catches the drainage of the slopes around it. The moist ground, cool shade, and northern exposure of this basin, forms an ideal spot for a fernery.

Thus there were provided a meadow and a grove, two very necessary adjuncts of a wild garden.

Crossing an intervening open space toward the south after leaving the grove, the top of the hill is reached. Here stands an aged white pine, the only survivor of a fire which swept over the place some years before. The blackened trunk, and upper branches extended imploringly, tell of its struggle for life On this knoll the soil is dry and poor, covered with a growth of small trees and heath plants. This is called Heath Hill. On the continuation of this knoll to the east stands a small summer cottage overlooking the St. John river and the Nerepis hills to the north. Sloping from the cottage toward the river is a cultivated field in which and along its borders may be placed those plants requiring full exposure to sunlight.

In this garden there have been about five hundred native species of flowering plants and ferns, many of which were *in situ*, while others have been planted during the last ten years; of these about ten per cent. have disappeared, or failed to grow through lack of proper conditions or the perils incident to long transportation, as the transfer of plants has been made chiefly in the summer months; so that not quite one-half of the flowering plants of the province can be seen in this space of nearly two acres. But little progress has been made in planting the grasses, sedges, rushes, and aquatic plants. The results in regard to the latter are especially disappointing, although considerable labor has been expended on them. The (at times) turbulent little stream has shown no disposition to be led into quiet ponds or stretches of pool. It has even carried away—root, stem and branch—the plants placed too confidingly within the limits of its bed, and all attempts to secure its co-operation, or at least a passive non-resistance in the scheme, have resulted in failure.

There is a larger representation of ferns in the garden than any other class of plants. Nearly all of the forty species and varieties found within the limits of the province were living and flourishing during the past summer. The trees and shrubs are also very well represented. Out of the eighty species found in the province, more than sixty are growing and in good condition, and in a short time I hope to have a complete representation of our forest trees and shrubs

Four years ago, Dr. Saunders, of- the Experimental Farm, sent me over one hundred plants representing, chiefly, the trees and shrubs of Western Canada and a few northern European species. These have been planted on the borders of the cleared spaces of the garden and are kept quite distinct from the native species. They, with a number of others, sent from Point Pleasant Park, Halifax, including the Heather *(Calluna vulgaris)* have grown very well, although but little care has been given them. These will serve for comparison with similar native species as well as to illustrate the effect of our climate upon them.

Little or no attempt has been made to put plants in rows or beds according to their classification, the chief aim being to provide a natural habitat and surroundings as far as possible. The only exception to this was the treatment of weeds, a colony of which, for prudential reasons, I placed in a row beyond the pale of other plants. With a perversity characteristic of their tribe, they spurned such treatment and refused to grow.

Another family which does not take kindly to cultivation is the Orchids. Many of these, of which we have so many beautiful native species, affect a solitary habit and are found in bogs. Others love the rich mould of deep sheltered woods. Others such as the Calypso, are rare or local in their occurrence.

In the future, I hope to present to the Society at the close of each season, a few notes embodying the results of observations, especially on the rarer species and those less susceptible of "cultivation," together with the time of coming into leaf, flower or fruit of certain species of plants, which on account of their commonness have been generally accepted as the basis of observation. In making such observations, there is a great value in watching for results on the same spot of ground or the same plant, or one quite near it, from year to year. This I have endeavored to do after being assured that the plant has adapted itself to its changed conditions, and had been long enough in the garden to be relied on to furnish correct data. In the results recorded below, I have not hesitated to go outside the garden to make observations on plants more favorably situated for coming into leaf or bloom early, always choosing the same locality, and, in the case of perennials, the same plants from year to year.

The observations recorded below have extended over a period of ten years, from 1889 to 1898, inclusive. They are not so complete as

I would wish, as my visits were generally confined to one day each week (Saturday) in the months of April and May. I give the results here, however, as they may be useful for comparison with those to be made later, which I hope will be fuller and extending through whole seasons.

Observations in Wild Garden and Adjacent Fields, Ingleside, Kings Co., N. B.

1889.

May 4. Plants in bloom: Adder's-tongue (Erythronium Americanum), Mayflower (Epigæa repens), White Violet (Viola blanda), Gold-thread (Coptis trifolia), Bellwort (Oakesia sessilifolia).

May 11. Purple Trillium (Trillium purpureum), Painted Trillium (T. erythrocarpum), Grove Anemone (A. nemorosa), Spring-beauty (Claytonia Virginica), Hobble-bush (Viburnum lantanoides), Blue Violet (Viola cucullata), June-berry (Amelanchier Canadensis), Strawberry (Fragaria Virginiana).

May 17-20. Rhodora (Rhodora Canadensis), Blueberry (Vaccinium Pennsylvanicum), Painted Trillium, Hobble-bush, Red Cherry (Prunus Pennsylvanicum), Shad-bush (Amelanchier botryapium).

(Hereafter the common names of plants alone will be given except where species different from those above are named.)

1890.

May 3. Mayflower (blooming beside the snow banks on the barrens), Adder's-tongue (just beginning to open).

May 17. Adder's-tongue (in full bloom), Bellwort, Purple and Painted Trilliums, Blue and White Violets, Gold-thread, Red Maple (Acer-rubrum.) Mayflowers still abundant on barrens.

May 23-26. Adder's-tongue, Blue and White Violets, still abundant. June-berry, its pure white petals making a beautiful contrast with the delicate green of the unfolding leaves of surrounding trees; Service-berry, Strawberry, Hobble-bush, Grove Anemone.

1891.

May 2. Mayflower, Adder's-tongue. (A few in bloom).

May 9. Adder's-tongue (in full bloom), White Violet, one Blue Violet.

May 16. Trees still leafless. Weather dry. Cold and backward.

May 23. Trees (White Birch, Poplars and Maples) just coming into leaf, and fully expanding in the next two days under the influence of warmer weather. In bloom—Strawberry, Blue Violet, Red-berried Elder (Sambucus racemosa), Gold-thread.

1892.

April 2. No signs of leaves or flowers unfolding. Plenty of snow in hollows, but day warm and bright.

April 18. Willow and Alder catkins beginning to shed pollen, Adder's-tongue leaves above ground. Very cold north winds.

April 30. Mayflowers in full bloom on barrens. Cold north winds continue.

May 7. Adder's-tongue (in full bloom), White Violet, Mayflower, Sweet Coltsfoot (Petasites palmata).

May 14. Bellwort, Grove Anemone, Blue and White Violets.

1893.

April 29. Hepatica triloba (planted the previous year) beginning to bloom beside a snow bank.

May 13. Mayflower, White Violet, Adder's-tongue, Selkirk's Violet (Viola Selkirkii , Hepatica, Red Maple.

May 20. Blue Violet, Grove Anemone, Bluets (Houstonia cærulea), Spring-beauty, Gold-thread, Bellwort, Blossoms of Red Maple falling, White Birch and Poplar trees unfolding their leaves.

1894.

April 28. Hepatica (in bloom), Alder and Willow catkins elongated and beginning to shed pollen. Patches of snow still visible in clearings and hollows. Adder's-tongue leaves above ground; a few flower buds visible. Mayflower has been in bloom for ten days in exposed places on the barrens. Strawberry (a few scattered blossoms).

May 12. Bloodroot (Sanguinaria Canadensis), Blue flowers of Hepatica falling with white in full bloom. The Purple and Painted Trilliums, White and Blue Violets, Bellwort, Star-flower (Trientalis Americana), Red Maple, Dandelion, Strawberry, in full bloom. Flower buds of June-berry and leaf buds of Red Cherry and White Birch ready to open. Frost out of ground and gardening commenced.

1895.

April 20. Weather warm and sun bright, with south-west wind. Catkins of Alder shedding pollen. Leaves of Adder's-tongue above ground. (No further observations this year on account of absence.)

1896.

April 24. Season dry with cold winds from March, continuing to the middle of May. Flowers of Alder shedding pollen.

May 1. White Violet, Hepatica, and Red Maple, in bloom, with a few flowers of Adder's-tongue.

May 8-11. Adder's-tongue, Blue Violet, Dandelion, Strawberry, Bellwort, Ground Ivy (Nepeta glechoma), Grove Anemone.

May 15. June-berry, Blueberry, Purple and Painted Trilliums, Hobble-bush, Blue Violet, Dandelion, Marsh Marigold (Caltha palustris), Bluets

May 22. Red Cherry, Elder, Starflower, small flowered Crowfoot (Ranunculus abortivus).

1897.

May 7-10. Weather for first three weeks cold, with east winds and rain, with an occasional warm day. Hepatica, Adder's-tongue (only a few in flower), White Violet, Red Maple, Hazel (Corylus rostrata), Alders, Willows, Poplars, in full flower in shaded places,—in exposed places fading, with pollen shed ; Butterwort (Pinguicula vulgaris) with leaves extended in rosettes. This plant, with such northern ferns as Woodsia hyperborea, W. glabella, Pellæa gracilis, and others, were brought from the Restigouche, 200 miles farther north, the previous season, and were among the first in the garden to unfold their leaves and fronds.

May 14-19. Adder's-tongue (in full bloom), Painted Trillium (a few), White Violet (abundant), Blue Violet (a few), Grove Anemone, Bellwort, Gold-thread, Strawberry (beginning to flower), Mayflower (in shade), Marsh Marigold.

May 21-25. Bluets, Hobble-bush, June-berry, Purple Trillium, Dandelion, Ground Ivy.

May 30. Nodding Trillium (Trillium cernuum), False Mitrewort (Tiarella cordifolia), Rhodora, Red Cherry, Elder, Dandelion, Strawberry.

1898.

April 23. Season cold and backward, although the fine weather of February and March promised an early spring. Frost still in ground and cold east winds prevail. Mayflower (in bloom), Adder's Tongue with leaves above ground.

May 7. Hepatica and Red Maple (in full bloom), Alder and Poplar catkins shedding pollen, a few Adder's-tongue, Blue and White Violets (in bloom).

May 14. All the flowers named above in full bloom, with Bellwort, Grove Anemone, Bloodroot, Leatherwood (Dirca palustris).

May 20. Purple and Painted Trilliums, June-berry, Service-berry, Ground Ivy, Gold-thread, Spring-beauty, Marsh Marigold, Blue Cohosh (Caulophyllon thalictroides), Hobble-bush. Trees just leaved out: White Birch, Amelanchier, Poplars, Red Maple, Lilac, Mountain Ash, Red and Black Cherry. Buds just breaking : Horse Chestnut, Black Ash.

May 24. First Red Cherry blossoms, Gray Birch (Betula populifolia) just coming into leaf, Red Oak, Linden, (Tilia Americana), Elm, Sumach (Rhus typhina) bursting their buds.

ARTICLE IV.

THE BUTTERFLIES OF NEW BRUNSWICK.

BY WILLIAM MCINTOSH.

(Read December 6th, 1898.)

This list of New Brunswick Butterflies can only be considered a preliminary one, as very little collecting has been done in this province. There can be no doubt that with a more extended knowledge of the insect life of New Brunswick this list will be found incomplete.

In the past collections have been made by officers of the army and navy, but we have no detailed record of their captures. Among the early collectors whose specimens have remained in the province the following are perhaps worthy of mention.

A collection of Lepidoptera captured on the Ketchum estate, Fredericton, by Capt. Moody, A. D. C. to Governor Gordon. This collection is in the University of New Brunswick at Fredericton.

A collection of miscellaneous insects taken in the vicinity of St. John, by Mrs. C. E. Heustis. Mrs. Heustis was for a number of years a contributor to the *Canadian Entomologist*, and may be considered the pioneer entomologist of the Natural History Society of New Brunswick.

A collection of miscellaneous insects captured in St. John County, by Mr. H. E. Goold. This collection contains a number of very interesting species.

A number of insects, principally Coleoptera and Lepidoptera, collected in Kings County, N. B., by Mr. Gibson Williamson, of Oak Point.

These three collections are in the museum of the Natural History Society of New Brunswick. At the present time these combined collections contain less than a thousand specimens, and so represent but a fraction of the species indigenous to this section of Eastern Canada.

During the past two years much interest has been evinced in this branch of nature study, and during the present year a number of collectors have been working, over 3,500 specimens having been taken

in the vicinity of St. John and Fredericton during the past season. It is to be hoped that this interest will continue, so that in the near future something may be added to the meagre knowledge of the insect life of New. Brunswick.

The remarks on the species in this list are based mainly on the writer's personal observations during the past three years.

No doubt upon more extended research not only will many additional species become known, but a number of those considered not common will be found to be more abundant in other localities.

In the preparation of this list I am indebted to Dr. James Fletcher for the identification of doubtful species, and to Miss Edith Darling for a list of species found at Sussex, and to Mr. Geo. W. Bailey for a list of Fredericton butterflies with notes, and also for procuring a list of species taken by Mr. R. McL. Vanwart. Mr. Bailey also sent me a catalogue of Capt. Moody's collection. From the above lists all references to Sussex and Fredericton species have been taken.

I have followed Rev. C. J. S. Bethune ("The Butterflies of the Eastern Provinces of Canada") in adding in brackets "Mr. Scudder's name for the species whenever it differs from the name employed."

LEPIDOPTERA.

RHOPALOCERA.

Family NYMPHALIDÆ.

Sub-family EUPLOEINÆ.

Danias archippus, Fabr.

(ANOSIA PLEXIPPUS.)

This beautiful butterfly is usually rare in the vicinity of St. John and Fredericton, but it is occasionally seen in considerable numbers. Flies in July and August.

Argynnis idalia, Drury.

Very rare, only four specimens are known to have been taken in New Brunswick. Two of these, captured by H. E. Goold, are at present in the collection of the Natural History Society.

Argynnis cybele, Fabr.

This species is rare in the southern sections of the Province, and probably not abundant in any part of New Brunswick.

Argynnis aphrodite, Fabr.

This butterfly is common throughout the Province. It is frequently mistaken for A. cybele which it very much resembles, but may be separated from that species by its smaller size. Flies in July and August.

Argynnis atlantis, Edw.

Common at St. John, Fredericton, Sussex, Belleisle, Moncton and Chipman. This butterfly is more abundant than A. aphrodite, frequenting the same localities and flying in company with that species.

Argynnis myrina, Cram.

(BRENTHIS MYRINA.)

Abundant throughout New Brunswick. This is our most common Argynnis, flying from the latter part of June to the last of August.

Argynnis bellona, Fabr.

(BRENTHIS BELLONA.)

This species is rare in St. John County, and does not appear to be numerous in any part of New Brunswick.

Melitæa phæton, Drury.

(EUPHYDRYAS PHÆTON.)

Rare; a few specimens have been captured near St. John. On June 18th of the present year, Mr. Geo. W. Bailey captured a specimen at Springhill, York County.

Melitæa harrisii, Scud.

(CINCLIDIA HARRISII.)

A specimen of this species was taken near St. John by Philip J. R. McIntosh during the summer of 1897. Rev. C. J. S. Bethune (The Butterflies of the Eastern Provinces of Canada) gives New Brunswick as a locality for this rare Canadian butterfly.

Phyciodes tharos, Drury.

Abundant from early in July to September. The form MARCIA, Edw. being taken in the earlier part of the season, and the form MORPHEUS, Fabr. later. It is found in open meadows and fields during June, July and August.

Grapta interrogationis, Fabr.

(POLYGONIA INTERROGATIONIS.)

Forms UMBROSA, Lint. MORPHEUS, Fabr.

Rare in the vicinityof St. John, and probably not common in any part of New Brunswick.

Grapta comma, Harris.

(POLYGONIA COMMA.)

Forms DRYAS, Edw. HARRISII, Edw.

This butterfly is not uncommon at St. John and Fredericton. Also reported as occurring at Dalhousie, by Rev. C. J. S. Bethune (The Butterflies of the Eastern Provinces of Canada.)

Grapta faunus, Edw.

(POLYGONIA FAUNUS.)

This species is not so abundant as G. comma in this locality, and is reported as not common at Fredericton and Sussex.

Grapta progne, Cram.

(POLYGONIA PROGNE.)

Common throughout the Province, flying from May to October.

Grapta gracilis, Grote and Rob.

(POLYGONIA GRACILIS.)

Evidently rare. Mr. R. McL. Vanwart reports this butterfly from Fredericton. If the specimens have been correctly identified it will be an interesting addition to our New Brunswick list.

Grapta j-album. Boisd, Lec.

(EUGONIA J-ALBUM.)

This species does not appear to be common in the southern section of the Province, only two or three specimens have been taken in St. John County during the past three years.

Vanessa antiopa, Linn.

(EUVANESSA ANTIOPA.)

Abundant throughout the Province. Flying from April to October, but most plentiful during the latter part of August.

Vanessa milberti, Godt.

(AGLAIS MILBERTI.)

This species is not common in St. John County, but it is apparently more numerous in the interior of the Province.

Pyrameis atalanta, Linn.

(VANESSA ATALANTA.)

Common at St. John, Fredericton and Sussex, and probably abundant throughout the entire Province. Flies, from June to the latter part of September. This species was unusually numerous from the 16th to the 25th of June of the present year.

Pyrameis cardui, Linn.

(VANESSA CARDUI.)

This butterfly is usually abundant, but during the past three years has been rare in this neighborhood, although quite abundant twenty miles inland. Flies during June, July and August.

Pyrameis huntera, Fabr.

(VANESSA HUNTERA.)

This species is occasionally abundant, and is generally found flying with P. cardui.

Limenitis arthemis, Drury.

(BASILARCHIA ARTHEMIS.)

Not uncommon at St. John, Rothesay, Hampton, Belleisle, Fredericton, and probably throughout the entire province. Flying from June to the latter part of August.

Limenitis disippus. Godt.

(BASILARCHIA ARCHIPPUS.)

This interesting species is not very common. Specimens have been taken at St. John, Fredericton, Belleisle and Grand Lake. Flies in June, July and August.

Sub-family SATYRINÆ.

Neonympha canthus, Boisd Lec.

(SATYRODES EURYDICE, Linn.)

NEONYMPHA BOISDUVALLII, Harris.

This butterfly is not uncommon on the Belleisle and at Fredericton and Sackville.

Satyrus nephele, Kirby.

(CERCYONIS NEPHELE.)

EREBIA NEPHELE.

Abundant throughout the province. Flying in July and August. Frequenting swampy meadows and fields bordered by woods.

Satyrus alope, Fabr-

(CERCYONIS ALOPE.)

HIPPARCHIA ALOPE.

This species is reported from Fredericton, but appears to be rare in the northern sections of the province. It is very common in the vicinity of St. John. Frequenting the same localities and flying in company with S. nephele.

Satyrus alope nephele, Scud.

This buttorfly, apparently a hybrid between alope and nephele, is sometimes taken at St. John.

Family LYCÆNIDÆ.

Sub-family LYCÆNINÆ.

Thecla augustus, Kirby.

(INCISALIA AUGUSTUS.)

Not uncommon, but difficult to capture, owing to its small size, dark color, and the shrubby localities which it frequents. Flies in May.

Chrysophanus epixanthe, Boisd Lec.

(EPIDEMIA EPIXANTHE.)

This little butterfly is not uncommon in two or three localities near St. John, but it appears to be very local in its habits, frequenting the same places (sometimes only a few yards in extent) year after year. Flies in July and possibly into August.

Chrysophanus hypophlæas, Boisd.

CHRYSOPHANUS AMERICANA, D'Urban.

(HEODES HYPOPHLAEAS.)

Common at St. John, Fredericton, Sussex and Grand Lake, from June to September. This species is no doubt abundaht in every part of New Brunswick.

Lycæna pseudargiolus, Boisd Lec.

(CYANIRIS PSEUDARGIOLUS.)

This butterfly is very common throughout the province. The forms VIOLACEA, Edw., being very abundant in May and June, and the form NEGLECTA, Edw., less common, in June, July and August.

Family PAPILIONIDAE.

Sub-family PIERINÆ.

Pieris napi, Esper.

(PIERIS OLERACEA, Harris.)

A number of specimens have been taken at St. John, Fredericton, and on the Belleisle, but this species is no doubt uncommon throughout the province.

Pieris rapæ, Linn.

This species is an importation from Europe, and is our most common butterfly in New Brunswick. Flying from May to October.

Colias philodice, Godt.

(EURYMUS PHILODICE.)

Very common throughout the province. Flying from May to September, and during the present year as late as October 23rd.

Colias interior, Scud.

(EURYMUS INTERIOR.)

Usually not very common, but during the present year this species was unusually abundant, being much more numerous than C. philodice. Flying from July 9th to late in August.

Sub-family PAPILIONINÆ.

Papilio turnus, Linn.

(JASONIADES GLAUCUS, Scud.)

This species is common in every part of New Brunswick, and occasionally very numerous. Flying in June and July.

Papilio cresphontes, Cram.

PAPILIO THOAS, Boisd.

(HERACLIDES CRESPHONTES.)

Rev. C. J. S. Bethune, in his list of the "Butterflies of the Eastern Provinces of Canada," gives St. John, N. B., as a locality for this species. None of our local collectors have met with it. It is a southern insect and no doubt rarely occurs in this province.

Papilio brevicauda, Saunders.

At present we have no local record of the capture of this species, but Rev. C. J. S. Bethune, in his list of the "Butterflies of the Eastern Provinces of Canada," mentions it as having been taken in Dalhousie, N. B. When the insects of the northern sections of New Brunswick become better known, this butterfly will no doubt be found among them.

Papilio asterias, Fabr.

(PAPILIO POLYXENES.)

This species is usually abundant, but during the past two years it has been very rare in the vicinity of St. John. Not uncommon on the Belleisle and at Fredericton.

Family HESPERIDÆ.

Carterocephalus mandan, Edw.

This species is not uncommon in two or three localities near St. John, but it appears to be extremely local in its habits frequenting wood roads and open grassy places in woods. Flies in June and July.

Pamphila zabulon, Boisd-Lec.

(ATRYTONE ZABULON.)

The form HOBOMOK, Harris, is common throughout the Province, flying in June and July.

Pamphila leonardus, Harris.

(ANTHOMASTER LEONARDUS.)

This species is rare in this vicinity, only two specimens having been taken, and at present it is not reported from any other locality in New Brunswick.

Pamphila peckius, Kirby.

(POLITES PECKIUS.)

PAMPHILA WAMSUTTA, Harris.

The most common Pamphila in this locality, frequenting meadows and oat fields, found in every part of New Brunswick, flying in June and July.

Pamphila mystic, Scud.

(THYMELICUS MYSTIC.)

This species is found in the same localities as the preceding, but it is not nearly so abundant. Flies in July and August.

Pamphila cernes, Boisd-Lec.

(LIMOCHORES TAUMAS, Fabr.)

PAMPHILA AHATON, Harris.

Common at St. John, Fredericton, Hampton, and also abundant in Victoria County. Flies in June and July.

Nisionades brizo, Boisd-Lec.

(THANOS BRIZO.)

Rare in the vicinity of St. John, only two specimens having been taken.

Nisionades icelus, Lint.

(THANAOS ICELUS.)

Taken at St. John and Fredericton. This species is quite abundant in the vicinity of St. John, frequenting wood roads and pathways bordered by low shrubbery.

ARTICLE V.

NOTES ON THE NATURAL HISTORY AND PHYSIOGRAPHY OF NEW BRUNSWICK.

By W. F. Ganong, Ph. D.

14.—On the Lack and Cost of a Topographical Survey of New Brunswick.

(Read October 4th, 1898.)

It is of course known to the members of this Society that no unified topographical survey of New Brunswick has ever been made, and no complete topographical map of the province exists. The entire coast line has been surveyed by the British Admiralty which has employed triangulation checked by frequent observations for latitude and longitude, and the results are contained on the well-known admiralty charts. The United States coast survey has made some triangulation about Passamaquoddy Bay, and its results may be found in their charts and reports. In 1841-1843 Captain W. F. W. Owen made a fine traverse and triangulation of the St. John from its mouth to Springhill, but his excellent contour maps were never published, though there is a copy of them in the Crown Land Office at Fredericton. Aside from these, there has been no proper topographical surveying in New Brunswick, though some determinations of latitude and longitude have been made. Our latest maps, of course, embody all these data; but for the rest of the Province, they are made up of pieced-together surveys of the most diverse age scale and authority, and hence the best of them are incomplete and inaccurate in many places. Passing from horizontal to vertical topography, the data for the latter are so scanty that our best maps make scarcely an attempt to represent it at all, and show but an occasional hachure star for some very marked height, or, as in the Surface Geology maps by Mr. Chalmers, a limited use of hachures for local elevations. It is true the hachure system has been used on several maps to show special

ranges of highlands, etc., as on Baillie & Kendall's map of 1832. Featherstonhaugh & Mudge's of 1839 (followed on Saunders of 1842), but in these the data were most scanty and the results very erroneous. The hachure topography of the coast line of the admiralty charts is of course accurate, but is too narrow a strip to be of much service. At the present time the best maps elsewhere represent vertical topography by contour lines; for New Brunswick absolutely the only published maps using contour lines are the following: first, a very crude folder issued by a steamboat company showing the St. John below Fredericton, with neighboring heights, taken from Captain Owen's maps already referred to; second, some of the surface geology maps, which show a 200 or 220 feet contour line; third, the United States coast survey chart, No. 300, which shows a detailed and accurate survey with contour lines of a strip of our coast from the Waweig to above St. Stephen, the peninsula below the Ledge being thus the most completely and accurately mapped part of New Brunswick. A proper contour as well as an accurate outline map of the province can be based only upon a unified topographical survey.*

Naturally questions of first interest in this connection are the value and cost of such a survey. Two publications which give details on this subject are the following: "The Mother Maps of the United States," by Henry Gannett (in National Geographical Magazine, IV., 101, 1892), and "Topographical Surveys, their Method and Value," by J. L. VanOrnum (in Bulletin of the University of Wisconsin, Engineering Series, I., 331, 1896). From these works I gather the following facts: Accurate maps representing to the eye the vertical as well as the horizontal topography have these values—First for military operations; second, as a basis for property boundaries; third, for study of water powers, drainage, etc; fourth, for the building of railroads, saving immense sums in preliminary surveys; fifth for selecting the best routes for highways; sixth, for municipal improvements, water supply, etc ; seventh, as a basis for geological and other special maps. Most civilized countries possess such maps of their territory. Some, but far from all of the United States possess them. The cost of the surveys preliminary to these maps varies immensely with local conditions, scale, accuracy, etc. One of the greatest and best in the

* If the reader is interested to see a splendid model of modern mapmaking, which is at the same time an illustration of the remarkable liberality of the United States government to education, he should examine "Physiographic Types," by Henry Gannett, in "Topographic Atlas of the United States" It may be obtained for 25 cents from the Director of the United States Geological Survey, Washington, D. C.

world, the Ordnance Survey of the British Isles, cost about $200 per square mile, though many special areas cost far more. Such a survey of New Brunswick, with its area of 27,000 square miles, would cost $5,400,000. Of more practical interest is the cost in one of the American States. That of Massachusetts, with its excellent contour maps, cost $13 per square mile, which for New Brunswick would amount to $351,000, but it would really be more than this because of the unsettled state of the country and the more scanty data to start with, and would probably reach $500,000. If a survey of the Province were made according to the recommendations of the topographical commission which met at Washington in 1892, on a scale of one to thirty thousand (half a mile to one inch), with contour intervals of 20 feet, it would cost at least $25 per square mile, or in all $675,000. It is plain that we must wait long for a complete topographical map of New Brunswick.

15.—Upon Natural Pavements and Their Possible Misinterpretation in Archæology.

(Read November 1st, 1898.)

On the Nepisiguit River, just above the Narrows, on the left bank, the beach is formed of flat stones fitted together so regularly and set so nearly upon the same level as to suggest an artificial pavement. Indeed many a city of western Europe has pavements less perfect. The beach slopes gently towards the water and is underlaid by soft clay full of small springs. The stones are water-worn boulders of diverse composition, size and shape, but all have flat or nearly flat surfaces uppermost, and there are no considerable gaps between them. I think I have seen such pavements elsewhere, though never before such regular ones, but probably they are well enough known to students of surface geology. Any artificial agency in their production in this wilderness is out of the question, and they are probably formed by the action of the ice in the spring, which, grinding along the shore, would tend to press the boulders into the soft and yielding beach and to work and turn projecting angles about until a flat surface comes uppermost. If the river's course were to become changed, so that the pavement were no longer on a beach it would be a most puzzling structure and almost certain to be referred to an artificial origin. References to pavements occur not infrequently in local archæological

writings, and are sometimes taken to indicate the existence of early settlements. From the above it would seem possible that such pavements may sometimes be of purely natural origin, especially when on river banks and underlaid by yielding bottoms.

16.—On Attempts at Oyster Culture in Passamaquoddy Bay.

(Read November 1st, 1898.)

The distribution of the oyster in New Brunswick waters is peculiar. Along with several other distinctively southern molluscs, it is found abundantly upon our north coast, but not at all upon our southern shore, which is occupied entirely by sub-arctic forms. The causes of this seemingly anomalous condition are in the main well known, and are discussed fully in a paper in the Transactions of the Royal Society of Canada, vol. viii., section iv., page 167, and by Upham in American Journal of Science, third series, vol. xliii., page 203. The evidence seems to show that the oyster did once live all along the coast from the Gulf of St. Lawrence to south of Cape Cod, and hence also in the Bay of Fundy, but that it has been exterminated in the latter by the entrance of cold currents allowed by geological changes of the coast line. Hence upon theoretical grounds, any attempts to artificially grow oysters in Bay of Fundy waters may be expected to fail. I have been told that many years ago live oysters were placed in Oak Bay, a branch of Passamaquoddy Bay, but they did not live. Possibly, however, it was in this way the southern starfish *Asterias Forbesii*, was introduced into the Bay (noted in the Bulletin of this Society, No. IX., page 54), though it may be a relic of the former southern colony. In the fall of 1896, Mr. G. W. Ganong, M. P., placed in one or two fathoms of water on a good beach, near his cottage on the south side of Oak Bay, some seven or eight barrels of dead oyster shells and two barrels of live oysters from the Gulf of St. Lawrence. In 1897 some of the oysters were washed ashore attached to kelp, and were still alive, showing they had survived the winter. In 1898, however, none of those thus washed ashore were alive, though the attachment of the two valves to one another, and the fresh condition of the hinge, showed that some of the shells were those of oysters placed in the water alive. In September, I dredged several times over the place, but brought up only dead shells, though some of them

obviously belonged, by the test just mentioned, to those placed alive in the water. Neither the dead shells nor the seaweed showed the least trace of any young.

There seems to me no likelihood that oyster planting would succeed in this bay. Not only is the summer temperature too low for breeding, but huge starfishes, the oyster's worst enemies, are very abundant, and the wash of the heavy tides must at times cover the living molluscs with silt very deleterious to their growth

It is to be hoped that the presence of these shells in Oak Bay will not be taken by some future naturalist as evidence of recent natural occurrence of oysters in the bay ; and it is partly to prevent such an error that the present note is placed on record. There is a tradition that oyster shells were once found in an old Indian shell-heap at Oak Point, between this bay and the St. Croix river, but I think this very doubtful. The statement by A. Leith Adams in his "Field and Forest Rambles" (page 35) that quahog and oyster shells are abundant in shell-heaps in this region, is, of course, altogether an error.

17.—On the Nature of the Mud in Our Many "Mud Lakes."

[Read December 6th, 1898.]

The best maps of New Brunswick show a branch of the lowermost Nepisiguit Lake running as a cul-de-sac half a mile or more to the southward. Last summer I went into this branch in a canoe, and found it nowhere more than a few inches deep, while in many places the bottom came above the surface. This bottom consisted everywhere of soft, grayish, flocculent mud, from which, as the canoe was forced with difficulty through it, arose in large bubbles an abundance of a gas smelling like hydrogen sulphide. A pole thrust several feet into it touched no hard bottom except near the shore, and the mud brought up by it from depths greater than a foot or two was of a reddish rather than a grayish color. I collected abundant samples, and a microscopic examination has shown that it consists almost entirely of minute Plants, Desmids, Diatoms and other unicellular and filamentous Algae, alive on the surface grayish layer and dead in the deeper reddish layers. The members of the Society will recognize these forms as among the most varied and beautiful in form and sculpturing of all living organisms. This mud then is all alive on the surface, and grows where it is found, thus filling up the lake ; as the individuals die,

their siliceous shells gradually sink and become compacted, thus forming the valuable siliceous deposits (infusorial earth) often dredged from lakes for economic use under the name of "Fossil Flour." It is thus no doubt the great beds of diatomaceous earth were formed in past geological periods.

Another lake of this kind appears to be the Fifth Green River Lake, which according to J. W. Bailey ("The Saint John River," page 53) is "very shallow with a soft bottom of white mud, which the men call 'paint,' from its quality of sticking to the canoe-poles, like white lead." Of course there are plenty of others, and the question at once arises, whether the brown mud which gives the name "Mud Lake" to dozens of small shallow lakes in Maine and New Brunswick may not be of essentially the same nature, the different color resulting from admixture of peaty matters or other impurities. In any case it is a problem to determine what favors the growth of these organisms in some lakes and not others, and why they are so much purer in some than in others. Here is a good place for the student of the freshwater Algae of New Brunswick to begin his labors upon the most attractive group of Plants yet unstudied in our Flora.

To the unaided vision, nothing could be more unattractive than the muddy bottoms of these lakes; but with the microscope to aid, they become replete with a beauty of form hardly to be matched elsewhere in Nature.

18.—Preliminary Outline of a Plan for a study of the Precise Factors determining the Features of New Brunswick Vegetation.

[Read December 6th, 1898.]

The most marked tendency of botanical investigation at the present day is towards the elucidation of the dynamical factors determining structure and distribution in Plants. In the study of local Floras, it is taking the form of an attempt to find out the exact factors which place each plant where it is, and make it the size, form, color and texture it is, a discipline known as Ecological Plant-geography. Though a new study, many valuable contributions to it have already appeared in Europe and this country, and a great extension of the

bounds of knowledge in this direction may confidently be looked for in the near future. Much of this rapid progress is due to the stimulus given by the appearance of Warming's great work on this subject, a work likely to be viewed in the future as one of the classics of Botanical Science.* To the members of this Society, eager for the advancement of Science and scientific education in New Brunswick, this new phase of Botany must be of especial interest, and some formulation of it for this province will therefore be acceptable.

A complete treatment of the Ecological Plant-geography of New Brunswick will involve three parts, as follows :

PART. I. THE ELEMENTS COMPOSING THE NEW BRUNSWICK FLORA—An account of the species actually occurring in the Province and their habits here; a systematic list of all the species, with the situations they occupy, and the variations in their structure in the different situations. So far as concerns the listing of the species, much work has already been done by our local botanists, but the study of the other phases has hardly been attempted. The great difficulty in this study of habits is the lack of accessible guides in which its principles are distinctly formulated.

PART II. THE GEOGRAPHIC ORIGIN OF THE ELEMENTS OF THE NEW BRUNSWICK FLORA—

A. Present provincial and world distribution of the species.

B. Past History and Changes now in progression, including occurrence of Colonies, and Migrations.

This part is capable of, and needs, thorough statistical study, upon which suggestions will later be offered. It has already received some investigation by Dr. Matthew, Professor Fowler and others.

PART III. THE ECOLOGICAL COMPOSITION OF THE NEW BRUNSWICK FLORA—The vegetation of no very large region is homogeneous as to its adaptations, but segregates itself into Groups including plants, most diverse in their systematic relationships, brought together by their common adaptations to a particular set of external conditions. These groups as they occur in New Brunswick may tentatively be classified as follows.

* The original is in Danish, but the German translation is most used. It is entitled "Lehrbuch der Oekologischen Pflanzengeographie," Berlin, 1896. An English translation is said to be in preparation.

A Preliminary Ecologic-geographic Classification of the Vegetation of New Brunswick.

(Primary Divisions in part after Warming.)

SECTION 1. Groups in adaptation to other organisms—Includes Climbers, Epiphytes, Saprophytes, Parasites, Symbionts, Insectivora Myrmecophila, etc. All of these groups are of minor importance in our vegetation.

SECTION 2. Groups in adaptation to external physical conditions.

I. *Xerophytes* (*Desert-Plants*)—Typical forms entirely wanting in our Flora; represented only by xerophytic characters in species living where transpiration normally exceeds supply, either because water drains off quickly or for other reasons is available in but small quantity.	A. Rocky hills, etc. B. Sea-cliffs. C. Sand-dunes. D. Dry Barrens. [See also some features in L.]
II. *Halophytes* (*Strand Plants*)—But a few herbaceous species in our Flora; some inland colonies.	E. Gravel and Sand Beaches. F. Salt Marshes. [See also T.]
III. *Hydrophytes* (*Water-plants*)—Very well developed in our Flora.	G. Plankton. H. Algae, { *a* Marine. *b* Fresh water. I. Immersed Phanerogams. J. Stream and Lake margin. K. Fresh water marshes. L. Sphagnum Bogs, { *a* Flat *b* Raised
IV. *Mesophytes* (*Normal Plants*)—Comprises the great bulk of the vegetation of this section of America.	
1. Original Vegetation.	M. Coniferous Forest. N. Deciduous Forest. O. Mixed Forest. P. Intervales. Q. Flood-bank and Bar. [See also J.] R. Swamps.
2. Effects of Cultivation.	S. Common Crops. T. Reclaimed Salt marshes. U. Abandoned Lands. V. Burnt Lands. W. Roadsides and Dooryards.

The only one of these groups which has yet received study of this kind in New Brunswick is, *Lb* Raised Peat-Bogs, on which there is a memoir, far from adequate, in the latest volume of the Transactions of the Royal Society of Canada. I have done some work upon F and T, which I hope soon to bring to completion. But this is not a task for one student, but for many.

19.—On a Current Error as to the Location of (Nictor) Bald Mountain, Tobique.

[Read January 3rd, 1899.]

In discussions upon the still unsettled question of the location of the highest land in New Brunswick, Bald Mountain near Nictor Lake is often mentioned. Yet curiously enough most visitors to Nictor Lake have identified the wrong mountain as Bald Mountain, and our two best maps of the Province, Loggie's and the Geological Survey, are also in error on this point. Rising abruptly from the shore of Nictor Lake is a splendid mountain, or rather, ridge, densely wooded to and over the top. This mountain was named in 1863 by Governor Gordon, Mount Sagamook, Maliseet for "Mount of Chiefs," ("Wilderness Journeys," 54). Professor Bailey in the same year climbed it and considered it Bald Mountain (Canadian Naturalist, April, 1864), and speaks of the error of the maps in placing it away from the shore of the lake. Chalmers also (Geological Report, 1885, GG, 11) considered Sagamook and Bald Mountain as identical, and the Geological Map names Sagamook "Bald or Sagamook Mountain." By all of these writers, and others, Sagamook has been considered the highest land in that vicinity, if not in New Brunswick. Yet Sagamook is not the same as Bald Mountain, nor is it the highest land in the vicinity. The real Bald Mountain, whose position is correctly shown on Wilkinson's map of 1859, is about three miles to the south-west of Sagamook, markedly higher, and has a perfectly bald conical top. It is this mountain which can be seen from far down the Nepisiguit, and which from the upper stretches of that river and from the Nepisiguit Lakes shows a bare top crowned by a wart-like projection. The reason for the failure of different explorers to see it seems plain. Sagamook is the mountain naturally climbed by all visitors, but its top is so densely wooded a view cannot be obtained from it, but only from some bare bosses of rock near the summit on the northern side, and it is only

from one of the most westerly, smaller, and probably least visited of these, that Bald Mountain can be seen. Otherwise one can see it only by climbing a tree on the southern edge of the summit of Sagamook, and it was from this position Bald Mountain rose before my astonished eyes, distinctly higher than Sagamook, on a fair day last August. If Mr. Chalmers' height of 2,537 feet, given to Sagamook, proves correct, then Bald Mountain may well be the highest land in New Brunswick.

20.—Upon Biological Opportunity in New Brunswick.

[Read January 3rd, 1899.]

Specialization in biological investigation is rapidly reaching such a point that in some lines, such as anatomy, morphology, physiology, embryology, it is becoming impossible to make discoveries away from the great centres in which extensive libraries, abundant appliances and considerable leisure are available. While therefore the local student is cut off from making contributions to knowledge in those lines, there are nevertheless other directions in which large possibilities for usefulness are open to him, namely in the study of *Occurrences, Distribution, Habits* and *Adaptations to External Conditions* of the organisms inhabiting his district. In such study the local student is liable at present to little interference from the specialists, for the latter are largely engrossed in laboratory problems.

Local Natural History is studied most of all by teachers, and next to them, by men of other professions and of business, who make of it a recreation or a hobby. If it were more widely realized what great and pure pleasure may be derived from the outdoor study of Nature, and how great an advantage it is to have some healthful engrossing subject to which one can turn for relief from the too pressing cares of life, the ranks of local naturalists would be overflowing. One must however possess the right temperament,—a love of outdoors, a fair measure of the collecting instinct, and a liking for one's own society, and one should begin young, and command some leisure. But for such persons there is no part of New Brunswick that does not offer ample scope for Natural History study with assurance of much personal profit and possibility of making some contribution to Science as well. But he who would enter upon such pursuits should not cover too wide a field, but, selecting that phase which most interests him, should devote himself to that. He should make careful collections for

himself, for his local Natural History Society, with which he should keep in close touch, and for specialists to whom he must turn for advice in all difficulties. He should gather books and papers relating to his subject, enter into correspondence with other students of it and publish accounts of his discoveries. Naturally he will explore first the region nearest about his home, then later in his holidays extend his journeys to other parts of the county or province he tries to cover. Thus gradually will he rise in his specialty until he comes to feel the joy of accomplishment, the charm of authority, and the satisfaction of having done something whose value is permanent.

The first and most important problem of local Natural History is that of *occurrences*—exactly what species occur within the given area and in what abundance. In New Brunswick, study of this kind has been made for the few groups that will be mentioned below. Its results are expressed in lists whose value is in direct proportion to their accuracy, which should be secured by asking the advice of specialists upon all doubtful points. Such lists are the very foundation of local Natural History study.

Second of local problems is that of *geographical distribution*, the precise range of species, not only in this Province, but also in relation to their distribution generally. Involved with this is the occurrence of colonies and the position of the lines of migration of species into the Province, and the proportion of the species that are derived from different directions, etc. Practically this could, I think, be best worked out by aid of simple small outline maps of the Province and of the World, on which the range of species could be shown in color, and new facts added as gained. I have no doubt that these maps, appealing to the eye, would suggest facts, principles, and clues for further study that the mere printing of localities in lists or tables would not. No such study of distribution has yet been made for any group of animals or plants in New Brunswick.

Third of local problems is that of *habits* of Animals and Plants. Surprisingly little is known accurately of the habits of organisms in a state of nature, and accurate records of fact in this line are most valuable.

Fourth of local problems is *adaptation of organisms to external conditions*, how their forms and sizes and colors are related to their habits and to outside influences, and especially how all these vary with the external conditions. It is true this division of local study is at present very difficult because of the lack of good books which can be

used as guides, books showing what facts are already known and what principles may best be used in further study. Such books are the great need of local Natural History study to-day, and they will prove as great a stimulus to it when supplied, as Gray's Manual, for example, has been to the study of classification of the flowering plants.

To these problems may be added another of no small importance, the *local and aboriginal names and uses* and *folk-lore* of plants and animals, and other *historic associations*, including their relation to the early settlement or progress of the country.

The groups of New Brunswick Animals and Plants, with the work already done in listing them, is as follows. In cases where there is more than one list, only the later is cited.

PLANTS.

Flowering Plants. Fully listed for Occurrences in Fowler's List in Bulletin IV, with many additions in later Bulletins. Distribution, Habits and Adaptations yet to be studied.

Ferns, Lycopods and *Equisetums.* Listed with the Flowering Plants.

Mosses. Partly listed by Fowler Rep. Secretary of Agriculture of N. B., 1878), and in Moser's List in Bulletin XVI.

Liverworts. Preliminary List (very incomplete) by Fowler in 1878.

Lichens. Preliminary List (very incomplete) by Fowler in 1878.

Fungi. Preliminary List (very incomplete) by Fowler in 1878.

Algae. Marine : List by Hay in Trans. Royal Soc. Canada, 1887.
Fresh-water · Not at all studied ; a most attractive group.

ANIMALS.

Mammalia. List by Chamberlain in Bulletins III and X.

Birds. List by Chamberlain in Bulletin I.

Reptilia. No published list.

Amphibia. List by Cox in Bulletin XVI.

Fishes. List by Cox in Bulletin XIII.

Insects. List of Butterflies in this Bulletin ; others to follow.

Crustacea. No published lists.

Worms. No published lists.

Mollusca. Marine : List by Ganong in Bulletin VI.
Land and Fresh-water : No published lists.

Echinodermata. Attempt at a Natural History of this group by Ganong in Bulletin VII.

Coelenterata. No published lists.

Protozoa. No published lists.

From the above it will appear that even preliminary lists have been made of but a part of our groups, and that hardly any study at all has been made of Distribution, Habits, or Adaptations. Here is scope enough for many students for a long time to come.

The logical end of all local studies in Natural History is the preparation of a complete Natural History of the Province. The characteristics of such a work I have elsewhere tried to sketch (in *Educational Review*, v, 141).

21.—BIBLIOGRAPHY OF THE FRESHWATER PEARL FISHERY IN NEW BRUNSWICK.

(Read February 7th, 1899.)

Pearls of considerable, and often great, value are occasionally found in the freshwater clams or mussels occurring abundantly in the brooks and rivers of North America, and there are periodical revivals of interest in the search for them. The latest Bulletin of the United States Fish Commission (Vol. XVII) contains a most valuable article upon this subject by George F. Kunz, entitled "The Freshwater Pearls and Pearl Fisheries of the United States," and to this the future pearl fisher will do well to turn. The work contains, however, but a single reference (on page 395) to New Brunswick. Additional data for this province are to be found in this Society's Bulletin, No. VIII, page 85, and in the St John *Sun* for October 26, 1889, and for November 2, 1889. Of some interest, too, is an article "On the Pearl," by J. Hunter Duvar, in Transactions of the Nova Scotian Institute, II, 86, 87, and a brief despatch probably exaggerated in the St. John *Telegraph* for November 15, 1898.

22.—WIND—EFFECTS ON VEGETATION ON THE ISTHMUS OF CHIGNECTO.

(Read February 7th, 1899.)

Every field botanist is familiar with the effects produced upon plants by winds blowing much in one direction, but these phenomena are shown upon an unusually large scale and in extreme degree upon the Isthmus of Chignecto. As one travels along the ridges in that district, he observes the trees bent strongly to the northeast with their branches trailing off in the same direction. This is of course best seen in the most exposed places, but is also well marked in many orchards; and where the wind has a clear sweep over a wide marsh, as at Sunken Island, the effects are particularly plain. Three examples, well marked though not extreme cases, are shown on the accompanying cuts, which are exactly traced from photographs taken along the Fort Cumberland Ridge between Point de Bute and Baie Verte. Of the three *a* is a yellow birch, *b* is a spruce, and *c* a hackmatack.

The cause producing these effects is perfectly obvious and agreed upon by all residents, *i. e.*, the great prevalence, particularly in summer, of southwest winds. The Bay of Fundy acts as a sort of funnel

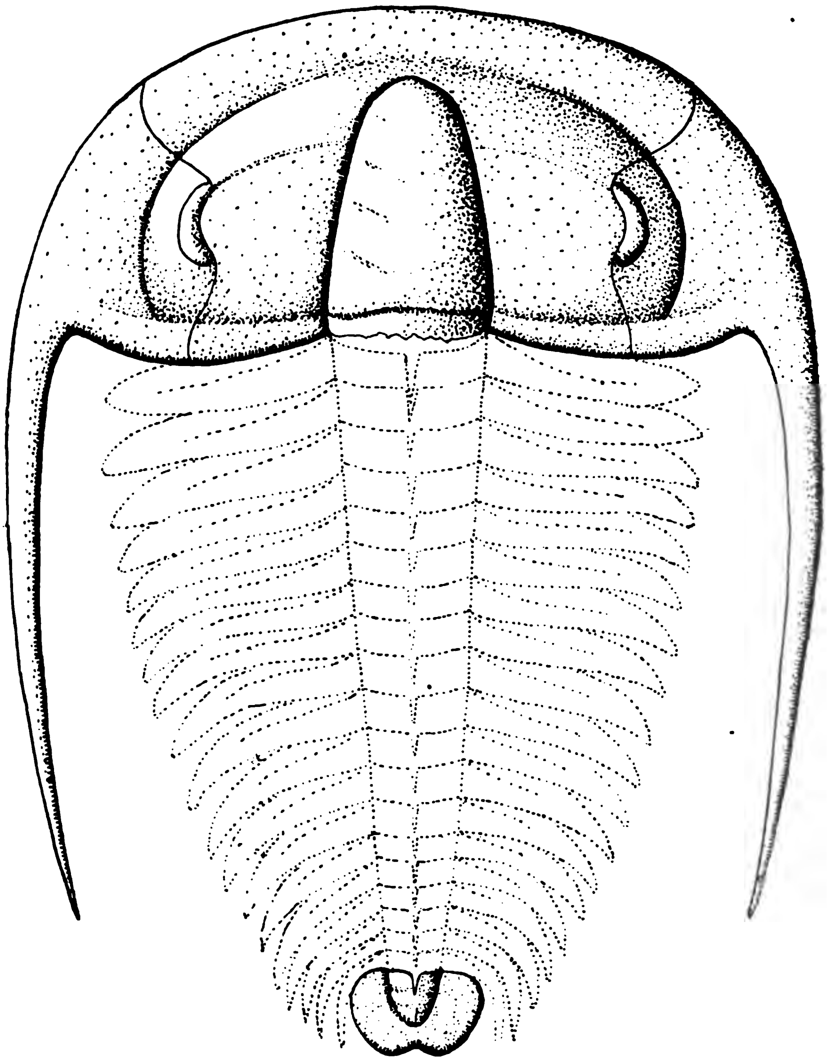
a b c

converging at the Isthmus. It would be of great interest to compare the aggregate prevalence of southwesterly winds and their velocity for a summer on the Isthmus with the corresponding facts for other parts of the province, but the data are not available, for there is no station for wind measurement in this district.

I have not studied the subject minutely but the effects are plainly of two and perhaps of three kinds. First, there is the mechanical bending of the growing shoots giving them all a set in the northeast direction. Second, there is diminished branch growth on the windward side ; this is no doubt due to the greater transpiration upon that side, for it is known that increased transpiration is accompanied by lessened growth of the transpiring parts. With this is correlated, too, an observable greater abundance of dead branches on the windward side. Third, it is possible, though not probable, that branch-development responds, to some extent, irritably to wind direction as a stimulus, in which event we would have a phase of Rheotropism.

One naturally looks in such a case as this for wind effects on other objects, but the only ones I have seen are occasional inclined telegraph poles, which on the Eddy road almost all lean strongly to the northeast, and the blowdowns in the burnt woods along the Ship Railway which are almost invariably in the same direction. More minute observation may show effects on the small lakes of the marshes and even also in some of the details of tidal movements.

PLATE III.



METADOXIDES MAGNIFICUS, n. sp.

Restoı ed—Reduced $\frac{2}{3}$.

ARTICLE V.

A NEW CAMBRIAN TRILOBITE.

BY G. F. MATTHEW, M. A., D.Sc., LL.D.

(Read February 7th, 1899.)

ERRATA.

"Article V."—A NEW CAMBRIAN TRILOBITE, read, Article VI.

we proceed to describe under the name

METADOXIDES MAGNIFICUS, n. sp.,

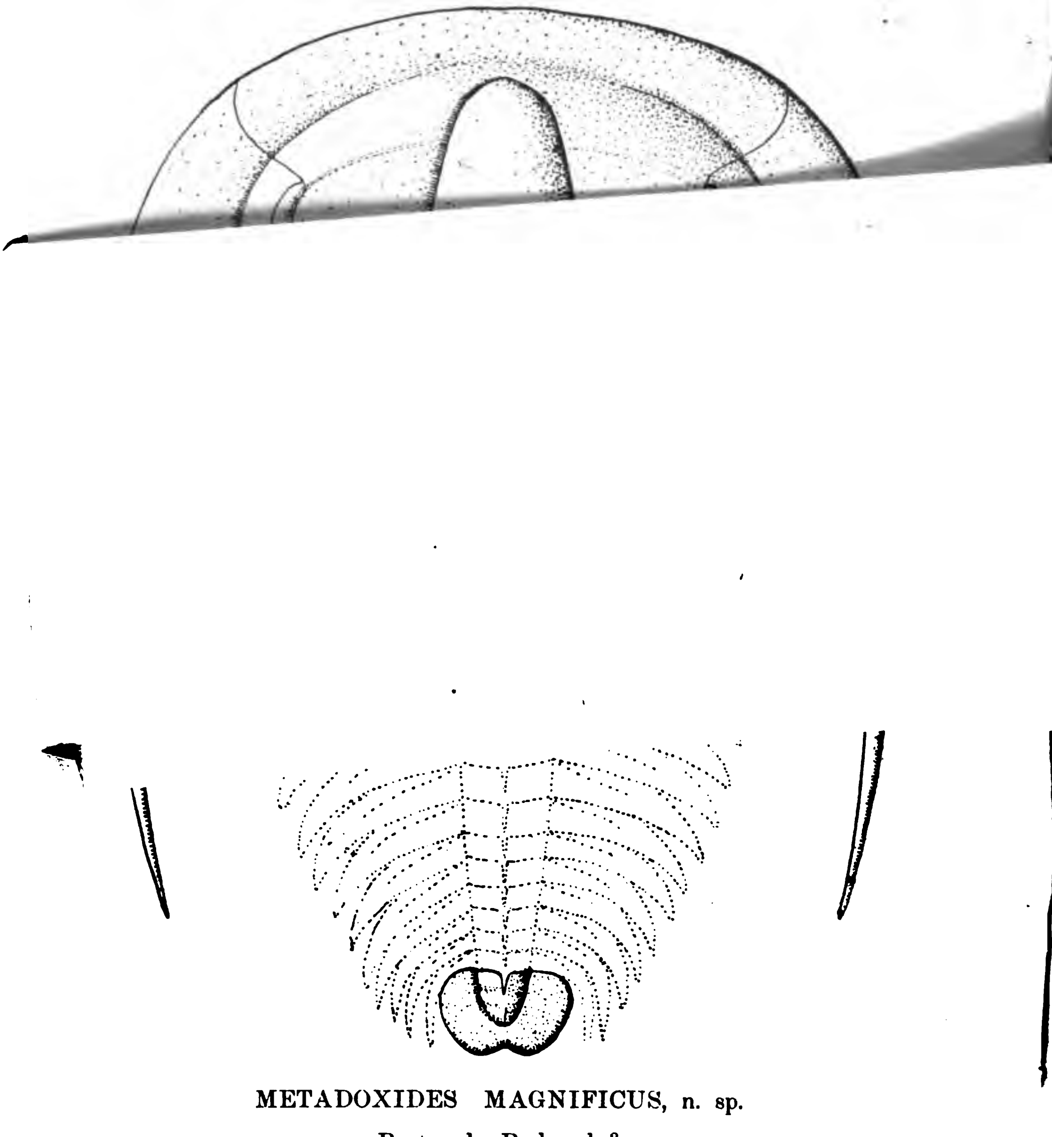
a species of the Lower Cambrian beds in Newfoundland.

A large species with wide, semicircular head-shield, and long genal spines. Middle piece of the head subquadrate. Front broadly arched; anterior marginal fold flat, and scarcely distinguished from the front area of the cheeks (in the flattened tests); the two together in front,

* "Fauna Cambriana-Trilobiti," Memoirs Geolog. Comm'n. Italy, vol. iii, pt. 2nd.
It would be more correct to say that Meneghini described two of the species of which he had only the thoraces under Paradoxides, and the third under Olenus. Bornemann having known heads and thoraces for all three, described them under his new genus.

† Die Versteinerungen des Cambrischen Schichtensystems der Insel Sardinien, von Dr. Joh. Georg Bornemann, Halle, 1891.

PLATE III.



METADOXIDES MAGNIFICUS, n. sp.

Restoıed—Reduced $\frac{2}{3}$.

ARTICLE V.

A NEW CAMBRIAN TRILOBITE.

BY G. F. MATTHEW, M. A., D.SC., LL.D.

(Read February 7th, 1899.)

During my visit last summer to Newfoundland I had the good fortune to discover a new link between the Cambrian of Europe and that of America.

In 1888 Meneghini described some trilobites which had been discovered in Sardinia under the genus Paradoxides,* but which are different from the types of that genus as known in the north and west of Europe. Subsequently, J. G. Bornemann redescribed these fossils under a new generic name, *Metadoxides.*† Bornemann found a decided difference between this genus and Paradoxides in the form of the glabella; this part of the head-shield in the latter genus is club-shaped, whereas in Metadoxides it is conical. Now, as the glabella is the most important part of the head-shield, and a part which exhibits prospectively in the larval form, its shape in the adult, it is important in generic classification, and it appears to me that Bornemann was quite right in dividing off his genus from Paradoxides.

Regarding the forms with conical glabella as a separate genus—

METADOXIDES, Bornemann,

we proceed to describe under the name

METADOXIDES MAGNIFICUS, n. sp.,

a species of the Lower Cambrian beds in Newfoundland.

A large species with wide, semicircular head-shield, and long genal spines. Middle piece of the head subquadrate. Front broadly arched; anterior marginal fold flat, and scarcely distinguished from the front area of the cheeks (in the flattened tests); the two together in front,

* "Fauna Cambriana-Trilobiti," Memoirs Geolog. Commis. Italy, vol. iii, pt. 2nd.
It would be more correct to say that Meneghini described two of the species of which he had only the thoraces under Paradoxides, and the third under Olenus. Bornemann having known heads and thoraces for all three, described them under his new genus.

† Die Versteinerungen des Cambrischen Schichtensystems der Insel Sardinien, von Dr. Joh. Georg Bornemann. Halle, 1891.

nearly half as wide as the glabella, both widen on each side of the glabella, so that at the facial suture they are as wide as three quarters of the width of the glabella, the marginal fold being the wider of the two. Glabella conical, bluntly pointed in the anterior quarter. The glabella and occipital ring together are about as long as half of the space between the facial sutures in front. The glabella has three pairs of furrows plainly shown, and a fourth pair faintly indicated. The furrows do not connect across ths axis. The occipital furrow and ring are not well preserved in the specimens known, but the furrow appears to extend quite across the back of the glabella. The fixed cheek is broad and flat, with a strongly arched eyelobe, about halfway between the side of the glabella and the edge of the head-shield.

The movable cheek is wide and strongly arched in the anterior part, becoming straighter behind. The area is about half of the width of the marginal fold in front, but less than that at the eyelobe. The posterior margin is sinuate, having a strong sinus near the genal spine ; and the furrow and fold are broad and weak. The genal spine is narrow, and more than twice as long as the movable cheek. The facial suture along the eyelobe is somewhat shorter (?) than behind it, and not quite so long as the anterior extension of the suture. This goes forward from the eyes with a sigmoid curve, to the nearest part of the anterior margin. The posterior extension of the suture is obscure in all the specimens obtained, but a detached free cheek appears to indicate that it was nearly direct to the posterior margin.

Only detached segments of the thorax are known; they have a narrow rachis and short pleura; the latter is traversed by a strong furrow, which in some (the anterior) run along the centre of the pleura, but in others begins towards the front side, and is more oblique; the pleura are bluntly pointed.

In the restorationof the thorax givenin *Plate III* the anterior pleuræ are longer than some examples would indicate, and the thorax wider; the number of segments is not known, but it may be assumed that they were numerous. In some pleuræ the ring has a tubercle or fractured base of a spine, on the posterior edge; it is supposed that there was a slender axial spine at the back edge of each thoracic ring, as such spines are found on the joints of the pygidium.

The pygidium is elongate semi-circular with a rather flat axis extending two-thirds of its length; three joints are present in the axis, of which the middle one bears a slender spine at the back; an ap-

pressed spine, which extends across the anterior joint, appears to belong to the posterior joint of the thorax. The side lobes are convex, and are of nearly equal width except at the back. The margin is entire, except that it is notched behind at the axial line.

Fragments of the hypostome have been found, but are not sufficient for description.

Sculpture. The surface of the marginal fold of the movable cheek is marked by widely spread, anastomosing, raised lines; along the front margin of the shield, close to the edge, a few of these lines appear, but are closely crowded, both on the free cheek, and on the middle piece of the head shield; along the genal spine the raised lines run diagonally downward from the outer to the inner margin; along the posterior border of the head shield there are crowded raised lines, as along the anterior border. On the doubleur the lines are crowded and more distinct. The edges of the ring of the rachis show similar crowded wrinkles; on some pleuræ there is a narrow band, or transverse wrinkling on each side of the pleural groove; in others the wrinkled band covers the whole under surface, and the wrinkles or raised lines become gradually drawn out in V-shaped lines along the pleura, so that towards its extremity they become parallel to the axis of the pleura. On the pygidium there are raised lines, but finer and more crowded, and parallel to the posterior border.

Size. Length of the middle-piece of the head about 70 mm. Width in front 110 mm.; at the eyelobe 95 mm. at the posterior angle about 90 mm. Length of the cord of the anterior extension of the facial suture 25 mm.; of the eyelobe 17 mm.; of the posterior extension about 20 mm. Length of glabella and occipital ring about 55 mm. width at third furrow 25 mm. at the first furrow 32 mm. Length of movable cheek 60 mm. and with general spine about 175 mm., width at the front 25 mm., at the back of the eyelobe 37 mm., at the posterior margin about 35 mm. Length of the pygidium about 20. mm.; width 27 mm.

Horizon and locality. Occurs in a very fine, greenish-grey shale, resting on volcanic ash rock, seen in a railway cutting at Manuel's Station, Conception Bay, Newfoundland. What appears to be the original surface of the ash rock in Cambrian time was uneven, and the fine mud of the shale settled into the inequalities of the surface. Almost directly upon the old rock surface, there is a layer of a few inches of shale abounding with the detached parts of this trilobite; the tests are confusedly crowded together, flattened and somewhat distorted in the shale, and are accompanied by a large Hyolithes.

On comparison with Mr. Walcott's section on Manuel's Brook, (a short distance to the north)‡ I find no volcanic rock mentioned, hence I suppose the rock on which the bed of shale rests that contains *M. magnificus*, belongs to the older Intermediate, or Huronian system. To the east of the ash rock are Nos. 3 and 4 of Mr. Walcott's section, hence it is presumed that No. 5 corresponds in position to the volcanic ridge, as a shore deposit, and that the bed of shale with *M. magnificus* will be at the bottom or near the bottom of No. 6 of Walcott's section. Here, it is stated, the head of an Olenellus was found.

This fine species shows many points of resemblance in a general way to *Holmia Broggeri*, Walc., but there can be no doubt it is distinct, if only by the fact that it has movable cheeks. The genal spines and pygidium differ also from those ascribed to that species by Walcott. It differs from all the Paradoxides in its conical glabella, as well as in the details of the ornamentation of the surface. *Solenopleura* (?) *Harveyi*, Walcott, resembles this species in some respects, but is much smaller, and belongs to a lower horizon (No 2) of Walcott's section.

In this species we have a good example of the Sardinian genus Metadoxides, and apparently the most primitive example of the genus known. *M. torosus*, Menegh., has just such a thorax and pygidium, but has evidence of more advanced development in the head-shield; this is chiefly in the shorter eyelobe, closer to the glabella, the more spreading course of the posterior extension of the dorsal suture, and the condensation of the head in front of the glabella. The meaning of these differences is apparent when we study the development of Paradoxides. *P. Acadicus*, for instance, shows a much wider extension of the marginal area of the head-shield in the larval, than in the adult stage. The withdrawal of the eyelobe from the vicinity of the margin toward the glabella, is seen to be one of the progressive changes that occurred during the growth of the Ptychoparinæ of the Paradoxides Beds at St. John. The short posterior extension of the dorsal suture is an almost universal characteristic of the trilobites of the Protolenus Fauna. Here, then, are three criteria from which we may infer the Newfoundland species to be an older type of Metadoxides than those of Sardinia.

Another species of Sardinian Metadoxides (*M. Bornemanni*) does not show such primitive characters as *M. torosus*, for not only is the whole head more compact, but the condensed pygidium with its

‡ U. S. Geol. Surv. Bull. 81, pp. 260, 261.

costate side lobes, introduces a feature quite at variance with the usual appearance of the pygidium in Paradoxides, and more like that in Conocoryphe; if this species may be retained with *M. torosus* in Metadoxides, there is greater reason for referring to this genus the new species from Newfoundland.

We have already called attention to the fact that the species described by Meneghini under the name of *Olenus Zoppii*, and now referred by Bornemann to his new genus *Olenopsis*, bears a close genetic relation to the genus Protolenus. In fact we may easily infer from the development of the individuals in certain species of Paradoxides that *O. Zoppii* is merely an advanced stage in the development of a Protolenus, in which those advanced characters have become fixed. Bornemann's representation of the development of *O. Zoppii* (in which, however, the figures appear to be somewhat conventional) will readily bear out the relation of this genus to Paradoxides, and justify our reference of Protolenus to the same rootstock.

And this leads us to remark that one of the fossils collected in Newfoundland last summer was a Micmacca, which by its somewhat shortened eyelobe showed an advance in development beyond the species found in the St. John Basin in New Brunswick. Another trilobite, an Avalonia, from the Newfoundland Protolenus Beds has a decidedly shortened eyelobe. It thus appears that one of the criteria of the Protolenus Fauna as found in New Brunswick, *i. e.* that the trilobites as far as known have continuous eyelobes, partially fails in Newfoundland; and in so far as it does so, would indicate that the Protolenus Fauna in Newfoundland (at least its middle and upper part) is of a somewhat later date than in New Brunswick. So far then, as opinion may be based on such data, the Protolenus Fauna in New Brunswick is one of the oldest assemblage of trilobites hitherto discovered, and that the migration of this colony has probably been through Newfoundland to Southern Europe. If the Sardinian species had come from the eastward we might reasonably have expected to find with them Olenellus, Dorypyge, or some other genus that has been elaborated in the region of the Pacific Ocean.

Reference to Plate III—*Metadoxides magnificus*, n. sp.—Reduced $\frac{2}{3}$. In this figure the different parts of the head-shield and the pygidium are placed in position. The thorax is restored from loose pleuræ which in the restoration should be shorter and blunter; number of segments unknown.

POSTSCRIPT.

Since writing the above, it has seemed to the author desirable to make a broader distinction between the Sardinian and American species of Metadoxides than that given above. He has heretofore depended upon the view of the Sardinian succession given by Barrande and Meneghini, from which one may infer the presence of two Cambrian faunas in Sardinia, the lower containing Olenopsis, Metadoxides, Paradoxides, etc., and the upper Giordanella (Asaphus, Menegh.) Neseuretus, etc.

Bornemann, however, seems to throw doubt upon the entire separateness of these faunas, when he says that remains of *Giordanella* are found with *Metadoxides armatus*.* If this is the case it will carry the whole Sardinian Cambrian fauna to a higher plane, and imply the separation of these by a wider space of time from the Newfoundland species described above.

Meneghini's view would admit of the following arrangement of the Sardinian as compared with the Atlantic North American Cambrian faunas.

	ATLANTIC NORTH AMERICA.	SARDINIA.
Upper Cambrian.	Dictyonema Fauna.	Giordanella Fauna.
	Peltura Fauua.	
	Olenus Fauna.	
		Olenopsis Fauna.
Lower Cambrian.	Paradoxides Fauna.	
	Newfoundland species described in this article	
	Protolenus Fauna.	

In this view the lower fauna of Sardinia might be regarded as intermediate homotaxically, between the Paradoxides and Olenus faunas. If, however, Bornemann's observation is to be relied upon, it seems to me that the whole fauna must be carried to the Upper Cambrian, notwithstanding the presence of a Paradoxides. It is therefore desirable to emphasize the point in which the Newfoundland species differs from the later, and supposed derived forms of Metadoxides, found in Sardinia, and apply to them sub-generic names, beginning with the most primitive.

1. Species having a widely expanded front to the cephalic shield; somewhat prolonged eyelobes; short posterior extension of the dorsal suture. No costæ on the side lobes of the pygidium. CATADOXIDES n. subgen. Example *C. magnificus*.

2. Species having a compacted front to the cephalic shield, short eyelobes, prolonged posterior extension of the dorsal suture.

a. No costæ on the sides lobes of the pygidium. METADOXIDES, sens. strict. --Ex *M. torosus*.

b. One or more pairs of costæ one the side lobes of the pygidium. ANADOXIDES n. sub. gen. Ex. *A. armatus*, *A. Bornemanni* (*A. arenosus ?*)

*Versteinerungen des cambrischen Schichtensystem der Insel Sardinien. p. 465. Halle. 1891.

ARTICLE VII.

ON ARTESIAN AND FISSURE WELLS IN NEW BRUNSWICK.

BY G. F. MATTHEW AND S. W. KAIN.

Read March 7th, 1899.

One of the authors of this paper has for several years been engaged in gathering information in reference to deep wells, bored in New Brunswick, and in the following pages the writers have endeavored to compare these borings, with a view to deduce practical results, that may be of general interest.

To show the full range of possibility in the origin and mode of flow of such wells, we have included some of less than 100 feet, which are often true artesian wells, penetrating only the surface deposits of the country.

With such inclusions we may divide the wells, referred to in this paper, into two principal classes. 1st. Those penetrating the surface deposits only, and those bored in the Carboniferous and Lower Carboniferous rocks, in which the sandstones, especially those of the Coal Measures, are porous, and so afford sources for artesian flows.—2nd. Those which penetrate the deeply buried Lower Carboniferous rocks, and those bored in the still older rocks which have suffered more or less metamorphic change, and in which the sandstones have been made impervious to water by the calcareous or silicious cement which has been deposited between the grains of the rock. From these latter rocks it is clear we cannot have true artesian flows, and must depend upon such water to supply the wells as may penetrate through fissures of the rock. In many of these wells there is usually no spontaneous flow, but the water has to be obtained by pumping.

Wells of the first class have not received the notice they deserve, for in many localities in the lower levels of the province, from sea level to two hundred feet above it, there are extensive plains and valleys of clay land, from beneath which the purest and best water for household and farm use may be obtained.

The artesian wells have been grouped into three sets, each of which has peculiar characters. Of these the first are those which penetrate the surface deposits only; the second are bored in the soft yielding sandstones of the Coal Measures; and the third penetrate Lower Carboniferous rocks of more varied nature, some of which have saline waters of marine origin, now held in soft red and brown shales, and sandstones.

The three wells of the first group are typical of the varieties of deposit which are likely to be met with in shallower wells. In Dr. Berryman's well we have the full series of the surface deposits which it is necessary to penetrate in order to reach the porous stratum containing pure water. The upper deposit here is the mud of a salt marsh forming an impervious covering to a porous stratum of sand, etc., of a seashore or estuary origin (Macoma sand), and therefore likely to give a decidedly brackish water. Beneath these sands there is a heavy bed of clay "brick clay" (Leda clay), which serves to hold in the water of the lower level; this water is contained in a porous stratum of sand and gravel beneath the clay. At this well the gravels are thought by the owner to rest on the rock, so that a still older part of the surface deposits, consisting of a confused mixture of clay, sand, and stones ("Boulder clay"), usually cemented into a hard, compact mass, is probably wanting at this particular spot, having been washed away by the current that laid down the gravel.

Of the well at St. Stephen we have less special knowledge; it is said to be situated on a ridge of land between two streams and penetrates only the brick clay. To have obtained water, however, the porous gravels below must have been reached.

Ready's well, in Fairville, is driven through a still more limited range of the surface deposits, for at this point the lower gravels swell out into a great ridge, with the brick clays resting on either flank, but not covering it. This well is driven in the gravels only (unless it may strike Boulder clay in its lower part) and the supply of water is drawn from the gravels alone, by direct gravitation, and does not necessarily come from a distance.

The second group of wells may also be regarded as artesian; they are bored in the sandstones of the coal measures which are "freestone"* and occasionally alternate with beds of shale, which would serve as an impervious covering to the several masses of sandstone. In

* Sandstones that are easily cut with the chisel.

a less degree the sandstones of the Lower Carboniferous series in which the wells of the third group are bored, are capable of transmitting water; their grains are frequently held together by a cement of calcite, which to some extent closes the openings between the grains.

As the second class of wells have largely been made in rock that is practically non-porous, the supply of water which such wells yield must come from joint or fissures in the rocks, and for good practical results it is obviously desirable that the positions in which such fissures are likely to be numerous should be known, and also whether there are chances that such fissures will be open, or fast closed by pressure.

Proofs that there is a pressure in a horizontal direction approximately from the southeast, have been observed at Monson, Mass., by W. H. Niles,* at New York by Prof. J. F. Kemp,† and at St. John, N. B., by one of the writers.‡ Such pressure would have a tendency to close fissures that were at right angles to it, especially where they occur in yielding rocks like slates and soft schist, but would not interfere with those that are horizontal, or run in the direction of the the pressure. Hence joints with a low hade to the southwest, or joints with a northwest course are in this region more likely to carry water, than others.

Dr. W. O. Crosby, of Boston, has marshalled evidence to show that joints do not extend to very great depths,§ and are most numerous in the rocks toward the surface of the earth, hence in going down on these fissures one may expect to find a level where the water is held by the cessation of the fault or joint. Under these conditions where these joints or fissures are numerous, they act as reservoirs to hold fresh water that has been transmitted through them from the surface of the earth, to the lower levels.

Nordenskjold || from observations made on the coast of Finland and Norway, has drawn the conclusion that at a certain depth in metamorphic and crystalline rocks, *horizontal* fissures have been formed by expansion and contraction of the rocks, due to the difference in temperature of the rocks down to a certain depth in the summer, as contrasted with the winter. The rocks down to the point where they have a uniform temperature at all seasons, would contract in winter and expand in summer. The theory requires that at this level of

* American Journal of Science, March, 1872. † Trans. N. Y. Acad., August, 1895, p., 275.
‡ Bulletin of this Society, No. XII, pp, 39, 1894.
§ Geol. Mag., London, Sept. 1881, p. 316.
|| Journal Royal Geographical Society, Vol. X, No. 5, pp. 465-469, Nov. 1897.

uniform temperature, horizontal fissures should be formed, that would serve as reservoirs for water from the surface, and a means of transmitting the water from place to place horizontally.

So far we have no support for this theory from the phenomena of the deep wells sunk near St. John, unless the horizontal fissures are deeper than Nordenskjold found them to be in Finland. Of the wells near St. John that have given a generous supply of water, two, to the north of the harbor, draw their supply from a depth of 270 feet, and three to the east, from nearly four hundred feet in depth. It is true that owing to the greater extremes of winter and summer temperature, the anticipated horizontal fissures might be looked for at a somewhat greater depth here, than in Europe, but certainly not at such a depth as the water veins in the rocks near St. John are found to be. It is probable, therefore, that some other cause has been active in permitting the water to sink to these greater depths.

Explanation of the Tabular List of Wells.

Nos. 1 to 3 are entirely in the surface deposits. Nos. 4 to 8 are in the Carboniferous basin along the Gulf of St. Lawrence. Nos. 9 to 13 are in the Lower Carboniferous rocks of the Kennebecasis valley. Nos. 14 to 16 are deep wells; the first two are bored in Lower Carboniferous rocks, and, except No. 16, are supposed to penetrate such rocks only. Nos. 17 to 28 are fissure wells; except the first three they are all in the vicinity of St. John, or in the city itself.

"Date," refers to the year in which the well was bored.

"Depth," that of the well, in feet.

"Bore," diameter of the main portion, in inches.

"Pressure," indicates the height of the water in the well, in feet; the minus mark (—) indicates that it is below the surface, the plus mark (+) that it rises above it.

"Flow," indicates the number of gallons discharged by the well per hour.

"Temperature," was taken with the Fahrenheit thermometer.

"Water veins," the figures indicate the level in feet below the surface where the water enters the well.

"Height," this is in feet above sea level at high tide, except Sussex Vale, where it is reckoned from mean tide level.

"Kind of rock," the thicknesses are in feet, and the upper layers are mentioned first.

ARTESIAN WELLS

Bored in New Brunswick, referred to in this Article.

No.	Location.	Date.	Depth.	Bore.	Pressure.	Flow.	Temperature.	Water Veins.	Height.	Kind of rock penetrated.
1	The Marsh Road, Dr. Berryman,	......	93	.1½	−1½	ample	....	40, 92	Sea level.	60 ft. marsh mud, 18 beach sand, 38 brick clay, 1 coarse gravel.
2	St. Stephen, H. Graham	.. ...	40	......	−16	.... ..	.. ....	39	Clay ridge.	30 ft. brick clay, 1 ft. gravel.
3	Fairville, Jas. Ready	.....	104	.6	−24	ample	45°	103	95 ft. above sea level.	Gravel, sand and boulders.
4	Westmorland, C. Tormentine, average of several,	....	100	......	+3	....	....	75, 100	25 ft. above sea level.	Grey sandstone.
5	Newcastle, Public Square	'88	120	.3	+6	....	45°	120	Near sea level.	15 ft. surface deposits, 11 ft. freestone, 94 ft thin, hard sandstone, with conglomerate and blue shale.
6	" R. H. Greenly..	'93	125	.4	−10	....	....	....	On a ridge.	25 ft. superficial deposit, 100 ft. sandstone.
7	" P. Hennessey	'98	140	......	+10	....	....	....	Near sea level.	Grey sandstone.
8	Chatham, Bank of Montreal	.....	180	.8	+7	... ..	....	....	do.	Grey sandstone. Red sandstone, etc.
9	Millidgeville, Jewett's Mill	......	147	.6	....	small	....	22	About 10 ft abv sea level.	
10	Sussex, S. H. White...........	......	243	.6	+25	1666 ?	42°	....	Sussex Vale is 65 feet above sea.	221 ft. soft micaceous rock.
11	" G. S. Moore.............	'95	185	.5	+3	slow 15	....	3		160 ft. " " "
12	" Gordon Mills	'98	400	.5	+3	50	....	4		170 ft. brown sandstone, 25 coarse sandstone, 200 hard limestone [?] with quartz.
13	" Mrs. Jas. Lamb	'95	210	.5	+4	150	....	.. ..	....	100 ft. brown sandy shale.

FISSURE AND DEEP WELLS

Bored in New Brunswick, referred to in this Article.

No.	Location.	Date.	Depth.	Bore.	Pressure.	Flow.	Temperature.	Water Veins.	Height.	Kind of rock penetrated.
14	Albert Co., Albert..............	'98	345	.6	....	... ...	....	345	Near sea level.	Grey sandstone, gypsum, red sandstone.
15	Sussex, Geo. D. Slipp	'95	998	.5	—24	....	....	200 and below.	About 65 ft abv sea level.	60 ft. of clay to the rock, then 893 brown sandstone, 35 very soft sandstone, 10 hard sandstone.
16	Chatham, Pulp Mill	......	1400	......	....	....	. ...	100 & 1000	... .	Grey sandstone, etc.
17	Campbelltown, "Hotel Dieu". ..	'90	100	......	....	.... .	....	....	... .	100 ft. in solid rock.
18	Milltown, Cotton Mill............	'84	200	.. ..	....	....	....	....	Near sea level.	[Pyritous slates?] sulphurous water.
19	Kings Co., Hatfield's Point......	'97	282	.6	—25	ample	....	24, 80	do.	75 ft. sand, 10 clay, 297 hard rock.
20	Brookville. W. Wheeler..........	......	180	.5½	—15	100	.. ...	60, 130	do.	60 ft. limestone, 3 ft. quartzite, 67 ft. "whinn."
21	Simonds, Alms House	'97	760	.4	—18	15	Jan. 45°	404	About 30 ft abv sea level.	758 ft. black slate, 2 ft. quartzite.
22	(470 ft. W.)	'97	550	.4	—2½	2000	Dec. 43°	28, 40, 406	About 10 ft abv sea level.	Slates and flagstones.
23	Union Street, St. John, S. Jones,	'96	385	.4	....	1000	Feb. 45°	382	+58 feet.	52 ft. clay, 9 gravel, 317 black slate, 68 sandstone.
24	Portland Rolling Mill............	'80	275	.3	....	ample	Feb. 46¼°	... .	15 ft. above sea level.	Slates and hard sandstone.
25	Carleton, Lunatic Asylum.......	'98	515	.3	—140	1000	....	....	+124 feet.	Slate and limestone.
26	Fairville, Pleasant Point	......	640	.4	....	small	....	at intervals	Sea level.	Granite.
27	Mt. Pleasant Av., Convent Sch..	'94	521	.4	....	40	....	245	+219 feet.	Limestone, etc.
28	Adelaide Road, Ropewalk.......	'88	278	.3	0	ample	....	....	+60 feet.	Limestone, etc.

Additional Notes.

Information in regard to the above wells has been had from the following sources :

No. 1.	Dr. John Berryman.	No. 2.	Mr. J. Vroom.
No. 3.	Mr. Jas. Ready.	No. 4.	Mr. A. W. Dobson.
No. 5, 6, 7.	Dr. R. Nicholson.	No. 8.	Dr. J. Baxter and Dr. R. Nicholson.
No. 9.	Mr. L. Jewett.		
No. 10-13.	Messrs. D. P. Kent and W. N. Biggar.	No. 14.	Mr. F. G. Moore.
		No. 15.	W. N. Biggar and D. P. Kent.
No. 16.	Dr. P. Cox.	No. 17.	Rev. E. P. Wallace.
No. 18.	Mr. Jas. Vroom.	No. 19.	Mr. W. Perkins.
No. 20.	Mr. D. P. Kent.	No. 21, 22.	Mr. E. C. Woods.
No. 23.	Mr. R. Keltie Jones.	No. 24.	Mr. James C. Robertson.
No. 25.	Dr. Geo. A. Hetherington.	No. 26.	Mr. F. Stetson.
No. 27.	Messrs. John Kelly, W. Murdoch, C. E. and Count deBury.	No. 28.	Mr. R. W. Connor.

Nos. 5–7, Newcastle. In reference to Ritchie's well, Dr. Nicholson states that the interior of the pipe became clogged with a deposit of blue clay, but was removed by passing a hard substance up and down.

No. 8, Chatham. The same authority states that the well near the public wharf at Chatham, though 200 feet from the shore and above tide level, is affected by the rise and fall of the tide in Miramichi river, rising to the surface of the ground when the tide is full. Dr. J. Baxter records four wells that are 100 feet or more in depth, two of which throw the water above the surface of the ground two and seven feet.

Nos. 10–13, Sussex. D. P. Kent, the well borer, gives the following as the succession of surface deposits at Sussex : At the top one foot of loam, then thirty feet sand and gravel, then twelve feet clay of a light grey color, then — gravel and boulders (clean and smooth), finally ten feet of boulder clay.

As Sussex has no system of sewerage, water supplied from ordinary surface wells must be very liable to contamination. Prudence would suggest the use of water for potable purposes from deep wells for this and similarly situated communities.

No. 16, Chatham. Maritime Sulphite Fibre Co. ("Pulp Mill"). Dr. P. Cox says water was struck at 100 feet from the surface, there was only a small flow, which in boring deeper was lost. At the depth

of 1,000 feet an ample flow was met which rose nearly to the surface; the water proved to be saline.

No. 19, Hatfield's Point. Mr. W. S. Perkins says the height of the water in this well is not affected by the rising and falling of the St John River.

ANALYSES.

No. 24. Mr. W. H. Mowatt has made a preliminary test of the water from the well at Portland Rolling Mills and found considerable chloride of calcium, and some sulphate of calcium. The water does not appear to contain sodium, potassium or iron.

No. 23. The following analysis of the water at S. Jones' was made some years ago by Mr. Alfred E. Macintyre, a chemist, now at Morrin College, Quebec. The water is pure and free from sediment.

	Parts in 10,000		Parts in 10,000
Sodium Chloride	0.517	Magnesium Sulphate	0.735
Calcium Sulphate	0.127	Aluminium Phosphate	0.015
Magnesium Chloride	0.013	Sodium Hydrogen-Carbonate	0.003
Calcium Carbonate	0.826	Potassium Sulphate	0.042
Iron Carbonate	0.082	Calcium Chloride	0.778
Silicon Dioxide	0.118		
		Total solid constituents	3.256

(Signed) ALFRED E. MCINTYRE.

The absence of bacteria, and low temperature of this water, make it of great value to the proprietors for brewing purposes.

No. 10, Sussex ("Mineral Spring.") The following information is furnished by W. N. Biggar. Analysis: Each Imperial gallon of this water contains:

Chloride of Potassium	0.21	grains.
Chloride of Sodium	2.10	"
Sulphate of Soda	1.47	"
Carbonate of Soda	25.35	"
Carbonate of Lime	0.35	"
Silica	1.05	"

The water contains quite a percentage of sulphuretted hydrogen and also carbonic acid gas.

Experience derived from the boring of wells in the Cambrian slates and sandstones at St. John seem to point to certain conditions that are favorable to obtaining water, and others the reverse.

The Jones' well was started in black, fine slates of Division 3 of the St. John group, and no water was obtained until flagstones or

sandstones, presumably of Division 2, were struck. As the dip of the rocks would indicate a great depth of slates at this point, it is to be presumed that these slates have been overthrust on the sandstones by pressure from the southwest in past ages. Depending on this factor as the displacing force here, the water supply of this well would come from the rain-fall on the exposed ridges of Division 2 flags in the city of St. John.

While Mr. S. Jones obtained an ample supply of pure water by boring in the black slates, the Alms House Commissioners had a different experience on boring in similar black slates on the east side of Courtney Bay, parish of Simonds. There though they bored a well twice as deep as Jones' well, they struck no water vein of any consequence. At the suggestion of a member of this Society they bored another well 470 feet further to the north, near the margin of a ridge of Division 2 flags and sandstones, and from this well they obtained a supply of water quite sufficient for their needs. The dip of the Division 2 flags would bring them to the lower levels in this well.

Another well where a fairly good flow of water was obtained, was at the Portland Rolling Mill, Strait Shore, near the Falls. This well is also driven in Cambrian flagstones and slates, though its lower part may penetrate an outlier of Laurentian limestone which appears in the hill near by. The strata along this shore are effected by profound faults, and greatly displaced; these displacements would give additional facilities for the storage and transmission of water.

Some wells bored in the vicinity of St. John have not given such good results. That driven some years ago at Pleasant Point opposite Indiantown was wholly in granite and the yield of water was small. This may be accounted for by the fact that the granite hill at Pleasant Point is enclosed by more yielding strata (limestones and slates) and joints or fissures due to pressure and disturbance, would be found in the more yielding strata, while the hard granite would be comparatively free from them.

Another well which was carried down to quite a considerable depth, was that at the Convent School on Mount Pleasant Avenue. A well was sunk at this place some years ago by the late Mr. Robert Reid, and as the supply which he obtained was too small for the use of a large school, a deep boring was undertaken. The boring was carried down 300 feet below tide level and a moderate supply of water was obtained at a depth of 245 feet, or about the sea level.

Better success, however, attended the boring of a well at Connor's ropewalk, on the Adelaide road, which lies in a limestone valley between two granite ridges about a mile to the northwest of the Convent well. Here an ample supply of water was obtained.

Where we have ascertained the level at which the water stands in wells driven near the harbor or river, it would seem that the level is affected by that of the river; thus in both the Asylum well and that of Mr. Ready the water surface in the well is about the level of low water. At the Alms House, on the contrary, where the flow is unusually heavy, it rises considerablyabove high tide level.

The following may be suggested as working hypotheses to govern the search for water by deep boring in compacted sedimentary and in igneous rocks, to be proved or disproved by further exploration.

1. Water veins are most likely to exist in bands of such rocks that abound in joints or faults, rather than in bands where such joints are scarce; hence more likely to be found in valleys than on ridges.

2. In a complex of soft slates and sandstones the water veins may be looked for in the sandstones, not in the slates.

3. The water will stand in the wells approximately at the drainage level of the district, and not be lifted by artesian pressure as in wells of the first class.

In conclusion we may here call attention to the advantage of the comparatively inexpensive boring of wells in the surface deposits, to the porous stratum below the brick clays, from which in many flat and low-laying tracts in the province, pure and copious supplies of water may be obtained.

APPENDIX.

THE PRESIDENT'S ADDRESS.

A WILDERNESS JOURNEY—WITH SUGGESTIONS.

BY G. U. HAY.

Read at the Annual Meeting, January 17th, 1899.

To-night I shall depart, to some extent, from the usual order of an annual address and first take you with me in imagination on a canoe trip one hundred miles across northern New Brunswick—from the Baie de Chaleur to the St. John River. I would like to impart to you some of the pleasures of that trip,—the exhilaration that comes from poling a canoe up a rocky and swift stream and then dashing down long stretches of rapids, breathing the free air and taking in the glorious scenery of our northern woodlands. But no description of mine, I fear, can give any adequate idea of the reality of such a trip through the entire length of two of our most beautiful rivers—the Nipisiguit and Tobique—rivers whose windings among leafy woods bring into view at every turn such matchless scenery that I shall always feel my blood move more quickly at the recollection of that journey, with its pleasures as well as its trials.

No country of the world, perhaps, presents a greater variety and beauty of river-scenery than New Brunswick. From the tidal streams of Westmorland and Albert rushing in from the Bay of Fundy with impetuous haste to cover up muddy flats, on past the stretches of the lower St. John and Kennebecasis winding smoothly among green fields and meadows, we come to our northern rivers—the Miramichi, Nipisiguit, Tobique and Restigouche, leaping down from their mountain homes and running races with each other to the sea. Every river and stream has numberless tributaries, cradled among forests of pine and spruce and maple, rushing down the mountain sides, resting occasionally in quiet lakes, and gathering strength and volume from other tributaries as they sweep onward toward the sea. These streams

form a network over the whole province,—the delight of the canoeman now as they were in former times of his brother, the dusky savage.

In the summer of 1896 I accompanied Dr. Ganong down the Restigouche, an account of which trip was published in Bulletin XIV of the Society's proceedings. As we passed the mouth of the Upsalquitch we formed a plan to ascend that stream in the summer of '98, make our way from its headwaters to the Nipisiguit, reach the sources of that stream, and thence descend the Tobique to the St. John. Owing to difficulties in the way, chiefly the lowness of the water in the Upsalquitch, we decided to ascend the whole length of the Nipisiguit. The course for canoe trips is usually up the Tobique from Andover, and down the Nipisiguit to Bathurst. The reason of this is obvious; the Nipisiguit is the more difficult river to ascend, having a rise of 996 feet from Bathurst harbor to Big Nipisiguit Lake at its source, a distance of 80 miles, while the Tobique from the St. John river to Lake Nictor rises 625 in a length of 95 miles.

On the eighth of August we started from Bathurst with a canoe, camping outfit and a four weeks' supply of provisions, and were carried by team to Grand Falls, 21 miles up the river. A few miles beyond Bathurst we left the last settlement and soon the last house. Our intended course stretched through a wilderness, which for over one hundred miles contains no sign of a human habitation except a fishing lodge at the Grand Falls. The lower Nipisiguit is rougher than the upper portion, which some of its enthusiastic admirers told us was "full of quiet pools, and every pool full of fish." I well remember my first canoe trip many years ago from Bathurst to Grand Falls and return. Everywhere the scenery is strikingly wild and picturesque, and the river tossed into foam by numerous rapids and small cataracts, or whirling round huge granite boulders which lies scattered everywhere in the bed of the stream. The names "Rough Waters," "Chain of Rocks," "Moorhead's Rocks," "Pabineau Falls," and "Round Rocks," are suggestive of some of the perils of navigation on the lower Nipisiguit. The occasional glimpses obtained of the river as we lumbered along over the rough wagon road, gave it a great fascination when compared with dreary stretches of burnt lands with blackened dead trunks and branches along the road. The Pabineau Falls, about twelve miles from Bathurst, is a wild and beautiful spot, the river tumbling and breaking over a granite ledge into a deep chasm beneath—a choice spot for salmon fishers. On the adjacent

rocks was found the rare plant *Aster linariifolius*, this being the only known locality for it in the province.

Our first camping ground was on the border of a thickly wooded terrace near the head of the Falls, not far from the deserted "farm" of "Bear" Walsh, a once mighty hunter, who gained the name from his many contests with bears. His favorite plan was to dress in a bear-skin, amble on all-fours through the woods, and come upon the unsuspecting bruin, whom he invariably knocked out in the first round.

The Grand Falls of the Nipisiguit are less impressive than the Grand Falls of the St. John, although the scenery is wilder. The chasm through which the water pours by a series of pitches and rapids is very narrow. The first pitch is about fifty feet high and a second about twenty feet. After these plunges the dark waters pour swiftly through a narrow gorge, three-fourths of a mile in length, with perpendicular walls of rock on each side. So narrow is the space between these opposing walls that in times of freshet it is said sometimes to be completely filled, and the gorge becomes one long rapid of seething tumultuous waters.

The *Woodsia Ilvensis* was the fern most thoroughly established on the rocks about the falls, with a few patches of *Polypodium vulgare*. The blue flowers of *Campanula rotundifolia* filled crevices wherever its roots could secure a foothold. A few Habenarias and other orchids, the Wild Onion *(Allium Schœnoprasum)*, the yellow flowers of Utricularia, Ranunculus, and others were found on the shores of the stream above the falls.

From Grand Falls to Indian Falls, thirty miles further up, the river is very rough, and we had hired two guides to take us over this part. Next morning we began the ascent in a large dug-out, in which we were placed with our baggage, and our bark canoe was towed alongside. A horse was attached to the dug-out with the driver on his back. The other guide stood in the bow of the dug-out with a long pole in his hand to fend off the vessels from the rocks. By such conveyance as this it is possible to carry a large party and their baggage up the river. As many as five or six dug-outs may be placed side by side, and one horse, with skilful guiding to avoid shoals and rocks, may pull the whole fleet up stream. But it is a very matter-of-fact, even miserable, way to get up a stream. The water was pretty low, the dug-out scraped on the rocks, and our course was slow, giving abundant opportunity to observe the shores and the character of the river.

The Nipisiguit river deserves its name, (*Win-peg-y-a-wik*, angry waters). It is a succession of rapids, with a few falls making a "carry" round them a necessity. The river is comparatively wide and shallow, but with sufficient water to float light canoes in the dryest season. The rocky bed presents a good many obstacles to the canoeman, who has to be constantly on the watch to prevent "scraping." As our canoe had been somewhat battered on the Restigouche trip, and had not been improved by two years' storing in a dry place, we had to be especially careful to keep ourselves and it from parting company on the trip.

The Nipisiguit is like the Restigouche in some respects, but very different in others. There are no salmon above Grand Falls, the falls presenting an obstacle which they are not able to surmount. One rarely meets with the deep pools so common on the Restigouche, but the shallower pools are the abode of trout innumerable, and casts at any place on the river reward the angler with catches of fine specimens weighing from one to four pounds. The bed of the river is an interminable succession of rocks and shingle, while the bed of the Restigouche is almost everywhere overlaid with gravel. There are few terraces on the Nipisiguit, whilst these are picturesque features of the Restigouche, especially where they are crowned with fishing lodges, the abode of sportsmen. The flora of the Nipisiguit is less interesting and varied than that of the Restigouche, and affords fewer rare specimens, especially in ferns and those boreal species brought down by its branches from the hills and mountains of Quebec. The Restigouche has comparatively low land along its upper course, the land rising gradually into mountains along the lower stretches. In the portions of the Nipisiguit toward the mouth, especially above Grand Falls, the hills are low, the land gradually rising as the river is ascended until altitudes of from 1,000 to over 2,000 feet above sea-level are met with along its upper waters. The tributaries of the Nipisiguit are much less in size and volume than those of the Restigouche, except the southwest branch, which is nearly the size—even broader at the mouth—than the main stream. Many islands are met with in the Nipisiguit river, a few clothed with grass but many more covered with a growth of trees, some of considerable size. There are more wild animals—bears, moose, deer, caribou, along the Nipisiguit, the country being wilder and less frequented by sportsmen.

The monotony of our second days' voyage by the novel (to us) "horse and dug-out team" was destined to be rudely interrupted, and

the interruption came about in this way. After we had gone about four and a half miles we came to the "Narrows," a gorge with walls of nearly precipitous rock and dangerous water. Most of the baggage was carried round, and the remainder was entrusted to the guides who undertook to pole the dug-out through the rapids, with the result that it became a total wreck, and our supplies went to the bottom or floated down stream. Hurrying to the spot in our canoe we rescued from the greedy waters ham, butter, pork, fishing tackle, etc. But there were some things dear to our hearts that the angry waters would not yield up, and these were baked beans and the aluminum outfit, containing cooking utensils and dishes.

Guides are a necessity. They are also an encumbrance if not of the right kind. We decided to dispense with ours. The generous sportsman at the fishing lodge below Grand Falls improvised for us a cooking outfit. In the meantime our own had been recovered from the depths of a pool. Left to our own resources we pictured the delights of making our way unaided through the wilderness ahead of us, taking our own time, and examining whatever we chose,—a free life indeed, with a prospect of abundant ingenuity and exercise in overcoming the obstacles that lay strewn in our pathway.

About four o'clock on Saturday afternoon, August 13th, we reached Indian Falls, fifty miles from Bathurst, having poled our own canoe for three days without any mishap, covering in that time over twenty miles of very bad water. But we rejoiced in the prospect of a Sunday's rest in one of the wildest and most picturesque spots on the river, and the opportunity to review the events of the past week, estimate our resources of strength and provisions, and to form plans to reach the second haven of rest—the Nipisiguit lakes, thirty miles beyond Indian Falls. We had devoted ourselves almost exclusively during the past three days to the task of getting our canoe up through the rapids and over rocks that strewed our pathway "thick as autumn leaves in Vallambrosa." The last two or three miles of our journey to Indian Falls was the tug-of-war of the trip. Rocks and huge boulders filled the river, and there seemed at times not passage way enough for the canoe in the swirling waters as they eddied from rock to rock. When the rapids were too strong and the rocks made the poling of the canoe too dangerous, we towed it up by means of ropes.

The hills on each side of the river became higher and gradually drew nearer the banks as we ascended, occasionally forming overhanging precipices as on the Restigouche. Cool springs and gurgling

rivulets of ice-cold water were refreshingly near us all the way up from Grand Falls. Droseras and Utricularias were busy capturing insects in their cool mossy retreats on the borders of these springs. *Arethusa bulbosa* and other orchids, such as the purple fringed Habenaria, the *Habenaria dilatata* and *H. hyperborea*, *Arnica mollis* and other plants loving cool moist habitats were found in great abundance. Some fine straight specimens of scrub pine *(Pinus Banksiana)* were seen along the higher ground overlooking the river; some of these towering to the height of sixty or seventy feet forming ample groves. White birch, black and white spruce, fir, maples, black ash, cedars of large size, were the chief trees met with, while alder, mountain maple, cherry, mountain ash and other shrubs drooped over the water with clematis and bed-straw twining everywhere over their stems; the purple Joe Pye-weed seemed to crowd all the vacant spots, forming a tangle of vegetation most delightful to look upon, but very hard to get through, especially when it is remembered that the sweep of the freshet and ice in the spring causes every shrub and small tree trunk within its reach to point down stream. It is to the thicket entanglements of these shores that I owe what little skill I possess in poling a canoe up a rapid stream. When this trip was first planned, Dr. Ganong, with a generosity that overcame all my scruples, since I was not accustomed to pole a canoe up stream, offered to "do all the work' and leave me free to botanize along shore. I scrambled along that rock-strewn and tangled shore for the greater part of two days. On the third I got on board the canoe and seized the bow pole with a determination to stick to the ship at all hazards.

What a charm there was about that camping-ground at Indian Falls, with the pale light of the full moon coming to us over the dark hills of spruce and pine beyond our tent. There was no sound except the rushing of the waters, which was continually in our ears. We had a feeling that the roughest part of the river was past; for was not the assurance given us that the upper part of the river is a series of quiet stretches, "full of pools and every pool full of fish." A spirit of contentment is in the air. The coffee never gave out a more delightful aroma. The flapjacks as they were deftly turned in the air came down in the right place in the fryingpan and lay sizzling contentedly with a well-browned surface, done to a charm. We enjoyed with all the high spirits of boyhood the charm of outdoor life in the woods. We talked of everything under the sun: why a bountiful providence has given us the means of knowing when a flapjack is done on the one

side but has left us in the dark about the other side. Again, how many persons ought to compose a camping party. This was discussed with some warmth as each strove to outdo the other in deftly turning a flapjack, or win the palm in producing the richest brown surface. The question of number could not be definitely settled. *Four* and *three* were suggested, but these numbers were rejected as furnishing too great a variety of interests which would possibly clash. *Two* was a favorite number, but this was objected to also, the disagreement turning on the point: if one of the two should tumble from the canoe and go sprawling upon the flood, should the other laugh or maintain a proper gravity under such trying circumstances. Thus we whiled away the hours until sleep closed our eyelids on the fragrant fir boughs, with the murmur of the waters growing fainter and fainter.

The next day—Sunday—was bright and beautiful. The series of rapids known as Indian Falls extends up the river until a turn hides the waters from view. Here, as the level rays of the setting sun shone over the foaming waters and black boulders, there was a strange fascination in watching the effects of sunlight and shadow, the crinkling lines of sunlight playing around the huge boulders looking like monsters disporting themselves in a sea of gold.

On Monday morning we made a portage of about half a mile to get round these rapids, of which Indian Falls forms the eastern end. These portages are among the delightful troubles of a journey in the wilderness. One wished at such a time that the camping party consisted of four instead of two to share the toil. But it is to be done and we might as well do it cheerfully. We take it as a pleasure, and in two or three hours it is accomplished, over a pretty woodland pathway, well tramped for centuries by voyageurs through the wilderness. First, we take the canoe, binding our coats on the benches nearest the bow and stern, raising and turning it over at the same time so that it is carried bottom upward, with the benches resting on our shoulders — Indian style. Next the baggage is taken, carrying it as far as we can, putting it down and resting as we walk back for more, — after the fashion of Klondikers.

Then we launched our canoe, rejoicing in the prospect of the "quiet stretches ' beyond; but the rocks and rapids are ever present. We meet with a few pools "full of fish," but the fish are probably suckers, the trout hiding themselves at the foot of rapids or beneath overhanging banks. But finally the rocks and boulders which have

strewn our pathway for four or five miles become fewer, and we have a few gravelly stretches to our great relief, although they are soon succeeded by rocky ledges and shallower water.

The country has become more mountainous and the mountains are close to us on both sides of the river. Bald Mountain has been in sight since Saturday, and on Monday afternoon, at three o'clock we land at the point nearest to it and pitch our tent, intending to climb at early dawn on the following morning. Near us was situated a "bear camp," where the lumbermen store supplies of flour and salt pork for use the following winter. They are made very strong, to resist the attacks of bears, who frequently, however, get into them by tearing off portions of the roof. We had been authorized before leaving Bathurst to get into this one, bear fashion, and help ourselves if we ran short of supplies, but fortunately we were not in need.

Here was noticed *Euphrasia officinalis* and other foreign plants which had followed the lumbermen up from the coast. I had not noticed this plant at the camping sites on the Restigouche, while of the introduced plant *Silene inflata*, noticed in such abundance on that river, not a vestige was to be seen on the Nipisiguit. Such are some of the vagaries of that vagrant class of plants known as weeds!

We started at 5.20 next morning to climb Bald Mountain, and in about an hour reached the summit without any difficulty. From the top a beautiful panorama was presented to the view. We could trace the outline of the Nipisiguit from Grand Falls to its source in the Nipisiguit lakes, near which lay a number of high peaks, among them Bald Mountain of the Tobique rising from Lake Nictor. To the south stretched hills and mountains, descending to the eastward in ranges of low hills. The height of the Nipisiguit Bald Mountain above the Bay de Chaleur is given by Mr. Ells in the Geological Report as 1922 feet. There is a mountain to the north, on the opposite side of the river, with a bare summit nearly if not quite as high as this. The air on the top was bleak and cold, and even with our coats on we were glad at times to seek the shelter of an overhanging rock, although the day in the valley below was warm, even sultry. I found the vegetation rather interesting, with several boreal plants and the trees and shrubs all of stunted growth. The following is a list of the plants observed: *Vaccinium uliginosum* (its first recorded appearance in this province), *V. Pennsylvanicum*, *V. vitis-Idæa*, *Nemopanthes Canadensis*, *Pinus Strobus*, *P. resinosa*, *P. Banksiana*, *Larix Americana* (first place that I had seen it on this river), *Picea rubra*, *P. alba*, *Abies balsamea*, *Kalmia*

angustifolia, *Rhodora Canadensis*, *Empetrum nigrum*, *Betula papyracea*, *Populus tremuloides*, *Melampyrum Americanum*, *Aralia nudicaulis*, *Pyrus Americana*, *Pteris aquilina*, *Aspidium filix-fœmina* (the only ferns observed) *Diervilla trifida*, *Viburnum cassinoides*, *Solidago latifolia*, one willow, two or three lycopodiums, a growth of lichens that covered the rocks in every direction, chiefly the Iceland Moss (*Cetraria islandica*). These plants were collected within a radius of 25 yards of the summit.

It seems rather odd that in the reports of the Dominion Natural History Survey there are so few records of the plant and animal life of the province, when the surface geology is reported with so much care and minuteness. Here, for instance, was found a plant (*Vaccinium uliginosum*), the most conspicuous one on the summit of Bald Mountain, which has not been detected in any other part of the province so far as I am aware.

The scenery along the Nipisiguit, from Bald Mountain to the lakes, is grand and picturesque. Lofty mountains, whose rounded or dome-shaped tops form fine positions for extended and uninterrupted views, were constantly in sight, presenting great temptations to climb. Storms of rain, accompanied with thunder and lightning, were of frequent occurrence and added to the grandeur of the scene. Just after one of these down-pours, and while the hills were reverberating with the distant thunder, we rounded a turn in the river and came upon a Virginia deer and her fawn bathing in a sheltered nook—a pretty woodland picture. Islands become more numerous as we ascend the river, and low meadows on which were growing elms, maples and butternuts. The tall grasses and ostrich ferns, from four to six feet in height, gave evidence of a rich soil, while the asters and Joe Pye-weed contrasted with the vivid green of the rich vegetation around. Passing Southwest Branch, which comes in almost at right angles to the main stream, we reached in a short time after Portage Brook, whose source is near the Upsalquitch Lake. We congratulated ourselves that we had not come by that route, as the water was too low to float our canoe. Islands now become more frequent, dividing the diminished water of the river, and making our course tedious and laborious.

About three o'clock one afternoon we came to a stream, probably the Little Forks of the Nipisiguit, and here we obtained one of the finest views on the river. Just behind us was a high mountain, not less, we supposed, than 1000 feet above the river, and forming an

abrupt ending to the straight piece of river we had just traversed. The top was a perfect dome in shape, bare on the summit, reflecting from its bronzed surface the afternoon sun in a thousand matchless colors.

As we approached the Nipisiguit Lakes the water became less rapid, but more shoal, with low grassy stretches along the river, in which were seen the tracks of moose and red deer. *Viburnum Opulus* and *Viburnum pauciflorum* were abundant on the low banks, with the royal fern in large clumps.

On Friday, August 19th, at 1.45 we reached a haven in the first Nipisiguit Lake, seventy-seven miles from Bathurst Harbor, on the twelfth day of our journey, and pitched camp Number Ten on a piece of low ground at the source of the river. Since leaving our guides at the Narrows we had made an average of six and one-half miles each day.

Next morning we started bright and early to explore the Nipisiguit lakes, four in number, connected by short thoroughfares. Nature smiled on us, for never was there a clearer or brighter morning. We enjoyed the rare luxury of sitting down and paddling our canoe. That was a red-letter day in our calendar. A moose was sighted, three plants new to the province were found, and a stream was discovered not laid down on the maps. Of course the moose was not captured, as moose hunting was out of season. The three plants found were *Ranunculus circinatus*, *myriophyllum alterniflorum*, and *Carex utriculata*, var. *minor*. The three Nipisiguit Lakes lying to the east are only ponds of little depth and with soft muddy bottom, each not more than from a half mile to a mile in length. Big Nipisiquit Lake is a fine sheet of water, over two miles long, very irregular in shape, especially on its northern side, where there are several islands, with a long ridge (moraine) extending into the lake and covered with a fine growth of red pine (*Pinus resinosa*), and flanked on each side by narrow bays extending far into the land. In the western bay we found the camping ground on which for generations past aborigines and white men, mighty hunters and guides, had encamped. Here we pitched our tent, and that night and next day (Sunday) we called up in imagination and made them pass in array before us that motley host of hunters and warriors that had ascended the Tobique, crossed the portage, and thence down the Nipisiguit. The land around these lakes toward the east is for some distance

low and flat, showing that at one time it was probably one large sheet of water. South and west the land abruptly rises into several lofty peaks, the highest of which is Teneriffe.

On Monday, August 22nd, we "carried" across the portage, nearly three miles, to the Tobique Lakes, and on Tuesday climbed Bald (Sagamook) Mountain, which rises on the south side of Nictor Lake. I ascended this mountain in the year 1884 with Mr. Chalmers of the Geological Survey, having the same season made the ascent of the Tobique and the portage across to the Nipisiguit Lakes.

On the 7th October of that year I read a paper before this Society giving some of the results of observations made on the Tobique, with some adjacent tributaries of the St. John, so that any extended mention is not now necessary.

The scenery of this portion of the province is strikingly wild and picturesque. The two lakes which give rise to the Little Tobique river have a united length of over four miles, and are joined by a rapid and crooked thoroughfare difficult to navigate. Both lakes are very irregular in outline, with rounded points and deep coves, with virgin forests on all sides, the abode of moose, deer and caribou. Shallow ponds at the east extremity are fed by two streams. The temperature of the water here was found to be 41°F., the lowest met with on our trip, the next coldest being that of the stream flowing into the south side of Big Nipisiguit Lake (49°F.). Two plants new to the province were found here, *Potamogeton heterophyllus* and *Pyrola secunda* var. *pumila*.

We reached Andover on our trip down the Tobique the 30th August, after a pleasant and safe run of nearly 100 miles, through rapids and quiet stretches of river, rendered all the more enjoyable from our toilsome ascent of the Nipisiguit.

The list of plants, recorded on another page, contains eight species and varieties not hitherto recorded in the province. I am indebted to Mr. Walter Deane, and others, of Cambridge, for their kind assistance in determining difficult species, and to Prof. L. H. Bailey, of Cornell University, for determinations of the carices.

Our northern rivers are better known to outsiders than they are to our own people. In the course of a summer's exploration among them you would meet with a dozen foreigners to one native of the province seeking sport, recreation and rest in those wildernesses where the only

sign of a habitation is an occasional white tent, the only sounds the voices of woodland songsters, the roar of the wind through innumerable trees, or the rushing waters through foaming rapids. To be sure it is the sport of salmon or trout fishing, or hunting, that draws so many to these northern streams. A few are tempted to seek rest in the solitude of a wilderness, whilst still fewer go with some scientific purpose in view, such as a better knowledge of our natural history and resources. The members of our Dominion and Provincial natural history surveys have done great service in this direction; but the results of their observations are contained in reports not sufficiently available for general purposes, and not sufficiently minute to suit the specialist. What is needed is a studied and systematic investigation of our forests, streams, mountains, plants and animals, in order to acquire a fuller knowledge of the soil, climate and capabilities of the province. This can be done to a great extent by amateur students trained in our schools and colleges to observe and report accurately upon the phenomena occurring about their own homes. They should be taught to make observations with the barometer and thermometer; to make weather reports daily; to study the rock exposures and soils; to make maps on which would be outlined the courses of the streams in their neighborhood, the lakes, cleared and wild lands, mountains, valleys and plains; to measure the length, course, velocity of current, depth at various points of small streams in their vicinity; to give the dimensions and depth of lakes; to measure the height of hills and mountains, thus acquiring an insight into the use of the barometer and level, and incidentally the importance of barometric readings at different places; to be able to distinguish at sight and classify the native plants and animals of the vicinity, with observations on their habits, mode of life, uses, appearance, occurrence. To these studies and observations might be added the survey of school grounds and adjacent fields, the dimensions and height of the largest trees in the neighborhood, the depth of the snow in the woods in winter, the dates of closing and opening of lakes and streams, the migrations of birds, and other data that I will not here stop to detail, but which would be of the greatest value to science if made with accuracy and regularity. But how is all this to be done, and who is to do it? will be asked.

Children are born observers and investigators. They will become interested in and readily undertake such observations as I have outlined above, under proper direction. Such work will not interfere with school work,—it will rather stimulate and encourage a greater

zest for knowledge at first hand. Very little of such work can be done in the schoolroom. So much the better, if it is not, provided that the impulse and direction come from the teacher, in the organization of an Out-door club, a Ramblers' club, an Observation club, a Snow-shoe club, or whatever it may be termed, provided there is a definite end in view. Interested students will not be satisfied with investigations in their own district. They will come to find out that every hill, every valley, every river, stream, lake, bog, has some peculiarity, in formation or in the life which inhabits it, which stamps it as different from every other hill, stream, lake, etc., found elsewhere. They will have an interest in comparing their own section with others, and hence will travel into other sections or meet with other students to compare the results of their observations. This is the spirit of investigation that is abroad everywhere in this nineteenth century, and one is surprised that it has not taken a greater hold in this province, where so much awaits the enthusiastic and keen-eyed explorer, and where such matchless scenery tempts him to its rivers and woodlands.

In Massachusetts out-door clubs are found everywhere through the state for the exploration of its mountains, hills and streams. Many individuals in these clubs are tempted by fishing, hunting, or the mere love of adventure, but others are investigating the occurrence and extent of plant and animal life, and other out-of-door problems, combining this free life with the healthful exhilaration that springs from quest and discovery which give tone and relaxation to body and mind. There have been many in our own province who have united this spirit of scientific investigation with a keen love of nature, and among many I may mention the late Edward Jack, C. E, whose knowledge of the natural history and resources of the province were gained through explorations for many years, during summer and winter, over large areas of New Brunswick. If the results of these explorations, which were published from time to time in newspapers and magazines in Canada and the United States, could be collected and published, they would stimulate many amateur explorers to collect and publish information about sections of the province that are too little known. We have all been greatly interested in the physiographic and natural history notes that Dr. Ganong has furnished this Society, the results of his explorations in different parts of the province; and we have endeavored to give the widest publicity possible to these notes, with the hope that they will direct the attention of our amateur

naturalists and explorers to the rich field for observation that awaits them in New Brunswick. Dr. Ganong has pointed out that the highest mountain in the province is as yet a matter of conjecture; that the heights of but very few mountains have been determined with any degree of accuracy; and that a vast amount of information in the location of tributary streams, in the size and depth of inland lakes, with thorough and accurate measurements of mountains, lakes, streams, is yet required before the maps in many sections of the province can be reconstructed with accuracy. While the distribution and occurrence of the flowering plants of the province have been determined fairly well in a few sections, others have had only a passing glance by a few of our botanists, while vast areas of the province have not been examined at all for plants. With the exception of our mosses, ferns and algæ, no attempts have been made since Professor Fowler's list was published in 1879 to publish lists noting the occurrence of our lichens and fungi, the investigation of which promise to yield rich results to the botanists of the future.

The examination into the occurrence and distribution of animal life has not been as complete as one might wish, and there is consequently much ignorance yet as to the distribution of species, even of the larger animals, found in the province. Since Mr. Chamberlain's list of birds and mammals was published many years ago, no additional results have been made public. Dr. Cox has been steadily working up the fishes. No cne appears to be occupying the field of invertebrate zoology since Dr. Ganong published his results twelve years ago, and the field of insect life, in which Mr. McIntosh has made so promising a beginning in our own vicinity, has no worker outside of our society in the whole province,—at least no worker who publishes results. When this Society last year, through the generosity of a friend, offered a series of prizes for the best collections of weeds, insects and fungi, the results were meagre and disappointing, so far as the province at large is concerned. And yet the work done by our Society is on the whole very encouraging. It is to be hoped that as many as possible of our members will meet on the Restigouche this year with the Summer School of Science and give what encouragement we can to that body in its efforts to encourage the study of science.

But the workers are too few. Why is it? There should be hundreds of workers, not only in the cities but in the country districts, where now there is but one, or at least only a very few. These should be investigating and publishing their investigations in local papers, or

corresponding for information with the members of the Natural History Societies already established in the province. Is there a lack of interest in natural science among young people? There would not be if an interest is once aroused and some pains taken to maintain it. We all remember that when our summer camp was held at Lepreau what an active interest was taken in our investigations and at our evening meetings by the residents, both young and old, of the place. Two years ago, at St. Martins, you will remember what a large number of bright and intelligent students accompanied us on our excursions and gathered at our evening lectures. These had been trained to observe at the excellent school in that place; and it is to the teachers and schools that we must look for a foundation of the habit of trained observation, if the natural history of the province is to be studied so that the results will far exceed what has been accomplished already. The grand scenery of our province, its resources and natural history, should be examined by scores of active and enthusiastic young people to collect data, for which the scientific world has long been patiently waiting. But the greatest advantage would be to young people themselves in awakening their interest in the capabilities and fine natural scenery of New Brunswick, thus begetting a wholesome admiration and respect for their own country—a kind of loyalty that needs to be patiently and insistently cultivated.

REPORT OF THE BOTANICAL COMMITTEE.

The Committee on Botany reports the discovery of several species and varieties of plants new to the province, to which may be added the occurrence in fresh localities of a few of our rarer species, which will furnish data in the preparation of a revised list of New Brunswick plants. The committee regrets that there are so few workers, and would urge on all interested in this science the importance of investigating and making yearly reports of the plants which may come under their observation, either in their own vicinity or in their excursions from home. Such information in regard to our weeds, as well as of our fungi and other plants too little known, is greatly needed.

In the list appended the names of species and varieties new to the province are printed in full faced type. The numbers correspond to those in Fowler's catalogue (Bulletin IV). All those found on the Nipisiguit and Tobique lakes and rivers were collected by Messrs. Ganong and Hay on their recent trip across the province.

10*a*. **Ranunculus circinatus,** Sibth. Nipisiguit Lakes.
222*a*. **Myriophyllum alterniflorum,** D. C. Nipisiguit Lakes.
240 Cicuta bulbifera, L. Nipisiguit Lakes.
248 Conioselinum Canadense, Torr and Gray. Nipisiguit River.
285 Viburnum panciflorum, Pylaie. Nipisiquit River.
266*a*. V. acerifolium, L. Parish of Dufferin, Charlotte Co. Vroom.
311 Aster Novi-Belgii, L. Nipisiguit River.
312*a*. A. junceus, Ait. Nipisiguit River.
314 A. linariifolius, L. Nipisiguit River.
346 Artemisia caudata, Michx. Bull's Island, opposite Woodstock. Hay.
391*a*. **Vaccinium uliginosum,** L. Bald Mountain, Nipisiguit River.
406 Pyrola secunda, L., *var.* **pumila,** Gray. Head of Tobique Lakes.
407 P. chlorantha, Swartz. Nipisiguit River.
347*a*. Euphorbia maculata, L. Denis Stream, near St. Stephen. Vroom.
665 Juncus Balticus, Dethard. Nipisiguit River.
671 J. pelocarpus, E. Meyer. Nipisiguit River.
679 Sparganium simplex, Hudson. Nipisiguit River.
697 Potamogeton Spirillus, Tuckerman. Nipisiguit Lakes.
701*a*. **P. heterophyllus,** Schreb. Tobique Lakes.
707 P. pusillus, L. Nipisiguit Lakes.
758 Carex Scoparia, Schk., *var.* minor, Boot. Nipisiguit River.
768 C. stricta, Lam., *var.* ———. Nipisiguit River.

776 C. fusca, All. Nipisiguit River.
783a. C. laxiflora, Lam., *var.* **varians,** Bailey. Nipisiguit River.
799 C. filiformis, L. Nipisiguit River.
800 C. lanuginosa, Michx. Nipisiguit River.
811 C. utriculata, Boot., *var.* **minor,** Boot.
834 Alopecurus geniculatus, L. Nipisiguit River.
940 Lycopodium complanatum, L., *var.* **Chamæcyparissus,** Nipisiguit River.

I am indebted to Mr. Walter Deane and others, of Cambridge, Mass., for identification of difficult species, and to Prof. L. H. Bailey, of Cornell University, for decisions on the carices.

G. U. HAY,
Chairman Committee on Botany.

REPORT ON ZOOLOGY.

The Committee beg to submit the following notes. Mr. McIntosh has prepared a list of the Butterflies found in the province, which will be found in another part of the Bulletin. Next year it is the intention to publish further lists of our insects. The committee are pleased with the great interest taken at the present time in zoological studies in the province.

Insects.

During the present year, insects have not been noticeably injurious with perhaps the exception of the Tussock Moth, **Orgyia leucostigma.** Many of the trees in the city and suburbs were almost completely defoliated by the caterpillars of this species, and judging from the number of eggs on the trees at the present time. they will be very numerous during the coming summer.

WM. MCINTOSH.

Batrachians.

Hitherto but five species of Ranidæ have been recorded as found in New Brunswick. Rana catesbiana, R. clamata, R. virescens, R. silvatica and R. palustris. (See Bulletin XVI. pp. 64-66, 1898.)

It has been my good fortune, during the past season, to be able to add to the list the Northern or Mink Frog, Rana septentrionalis.

The first specimens, which were identified by Dr. Philip Cox, were taken in a small lake near Golden Grove Road. I afterward saw two other specimens at Murphy's Lake, near Treadwell's place, on the Loch Lomond Road, but only succeeded in capturing one of them.

The specimens taken were as follows:—Length, two-and-a-half inches; back, dark brown, almost black with lighter greenish vermiculations; white underneath, with a slight tinge of yellow on throat; muzzle green; limbs more mottled than barred, much the same as back; tympanum slightly smaller than eye, colored brown. Fold-down sides of back very slight, if any.

The markings of the backs of the younger were not so perfect as on those full grown, and there were two rows of large oblong blackish spots down the back, which are hardly discernible in the adults.

CHAS. F. B. ROWE.

BIRDS.

The numbers refer to the list of birds printed in Bulletin 1, 1883.

SECTION A.

(Species which occur in St. John and Kings Counties.)

147. Knot. Robin Snipe (Tringa canutus). A rare autumn visitant and only one reported as taken at St. Martins on September 8, 1881.

NOTE.—A female taken at Red Head Beach on September 5, 1898, by Wm. Hare.

152. Red-backed Sandpiper. "Dunlin" (Tringa Alpina Pacifica) a rare autumn visitant, two records, one each of 1 and 4.

NOTE.—A female taken at Quaco on October 12, 1898, by George Hare, Esq.

197. Rurdy Duck (Erismatura rubida). Only two instances of its occurence known (in addition a male and female were reported in Bulletin XVI (page 74) and I now have in my collection a female taken at Wickham, on November 4th, 1898, by John Craft.

A. GORDON LEAVITT.

A. GORDON LEAVITT.
WILLIAM McINTOSH,
CHAS. F. B. ROWE,
Zoological Committee.

METEOROLOGICAL ABSTRACT FOR 1898.

OBSERVATIONS RECORDED AT ST. JOHN OBSERVATORY. LATITUDE, 45° 17′ N.; LONGITUDE, 66° 4′ W.

D. L. HUTCHINSON, Director.

	Barometer.			Temperature.			Cloudiness: 0—Clear. 10—wholly clouded.	Precipitation Rain and Melted Snow.	Wind Direction and Velocity.																			Thunder Storms.
									N.		N. E.		E.		S. E.		S.		S. W.		W.		N. W.					
	Mean.	Highest.	Lowest.	Mean.	Maximum.	Minimum.			Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Calms.	Total Miles.		
January	29.96	30.68	28.94	16	42 9	−14.6	5	5.11	177	1271	74	796	26	243	24	344	38	590	40	599	59	665	174	2736	137	7,944	1	
February	30.09	30.70	29 02	26 7	41.8	− 2.6	7	3.59	71	465	147	1881	38	364	35	407	63	331	64	755	37	248	124	1337	93	6,288	0	
March	30.20	30.95	29.44	33.6	52 7	16.5	5	2.38	70	602	46	415	18	58	37	263	186	1496	123	1239	18	114	44	2438	112	6,544	0	
April	29.90	30.41	29 33	38 2	61.5	21 5	7	5.47	50	434	231	2818	24	205	51	366	33	133	62	601	30	225	154	2277	85	7,059	0	
May	29.98	30.41	29 61	48.9	68.3	29.2	6	1.27	42	349	145	1216	22	126	113	765	131	758	123	1179	4	26	55	729	109	5,148	0	
June	29.94	30.43	29.37	56 4	73.5	44	7	2.38	15	79	130	1019	22	99	94	558	186	1019	80	870	8	32	114	1715	71	5,391	0	
July	30.04	30.52	29.62	64.4	78.5	18	6	1.26	29	230	49	369	18	66	121	634	232	1899	112	971	6	27	62	474	115	4,170	1	
August	29.96	30.28	29.66	62 5	77	49 5	7	3.26	18	97	49	294	66	396	103	432	220	1141	74	878	10	112	68	605	186	3,955	1	
September	30.02	30.43	29.50	55.8	81.2	32.5	4	4.04	14	47	51	333	21	105	80	400	95	472	112	1249	44	515	158	2247	145	5,308	1	
October	30.10	30.62	29.41	47.1	73	29.5	6	7.50	39	392	125	958	23	102	73	950	41	267	166	2432	12	98	159	2182	106	7,371	0	
November	29.96	30.53	28.98	38.2	56.5	19.3	8	4.19	134	1675	167	2657	33	332	18	241	34	600	91	1378	30	383	144	1558	69	8,894	0	
December	29 95	30.67	29.19	23.9	44.2	− 8.7	7	4.21	37	322	115	1069	29	252	26	561	9	144	110	1414	111	1428	276	3904	81	9,004	0	

Barometer readings reduced to sea level and 32° Fahrenheit. The – when used indicates temperature below zero. The maximum temperature, 81.2, was registered on the 6th September; the minimum, – 14.6, on the 31st January.

MAGNETIC DISTURBANCES.

I am indebted to Mr. W. P. Robinson, of the Canadian Pacific Telegraph Co., for the following note:

The last magnetic disturbances of a serious nature were on September 9th, 1898, covering a period of five hours—from 11 A.M. to 5 P.M., St. John local time. The earth currents on this occasion were very constant. We worked with Fredericton part of the time without battery at either end. Although the manifestations of aurora were brilliant that evening, our circuits were not affected at all after 5 P. M. During the hours mentioned all circuits, east and west, were affected. March 14th and 15th of 1898 we also observed magnetic disturbances, on the latter date particularly being of unusually troublesome nature. On that date the aurora was of remarkable brilliance. We were affected between 2 and 9 P. M., local time. S. W. K.

EARTHQUAKE SHOCK, AUGUST 14, 1898.

A slight earthquake shock was felt on the above date at points on the St. John River between Torryburn and Oak Point. The first shock was felt at 3.09 A. M., the second at 3.14 A. M. (75th meridian time). The first shock was preceded by a slight noise; the second shock was sufficiently strong to overturn light objects, and aroused many of the residents at Ingleside, Westfield, Hampstead, Oak Point and Rothesay. Mr. Shewen, who was at Rothesay, said it seemed like a train approaching, followed by a shaking of the house. It was felt most severely in the vicinity of Oak Point.

S. W. KAIN.

THIRTY-SEVENTH ANNUAL REPORT OF THE COUNCIL

OF THE

NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

Your Council beg leave to submit the following report for the year now ending:

The past year has been both active and progressive. More frequent opportunities have been afforded the public to visit the museum. The lecture courses have been excellent alike, in variety and interest, and the attendance at meetings more than usually satisfactory.

MEMBERSHIP.

Thirty-six members were added to the rolls in the course of the year; but we have had losses, caused by resignations, change of residence and death, which have reduced the actual gain to the Society to twenty members.

We have to record the deaths of Henry F. Perley, who was for many years a life member; and of Mrs. Charles Medley, who took a warm interest in the Society and its work.

FINANCES.

The Treasurer makes the following statement:

Receipts.

Balance from 1898	$ 31 56	
Membership Fees	196 00	
Bulletins sold	13 00	
Interest on Investments	144 00	
Donations	37 00	
Dividends from Botsford Estate	30 00	
Prizes from Exhibition Association	20 00	
Donation, James Manchester, Esq	100 00	
Government Grant	125 00	
Carried forward	——	$696 56

Receipts carried forward		$696 56

Expenditure.

Printing and distribution of Bulletin XVI	$145 56	
Prizes for Provincial Exhibition	100 00	
Maintenance of Museum	223 74	
Library: Books and binding	40 00	
Miscellaneous	89 19	
Balance	98 07	
		$696 56

It will be seen that a balance remains on hand, but the whole amount will be required for the publication of Bulletin XVII.

Library.

For the first time in several years we are in a position to announce real improvement in this department. After some correspondence certain numbers required to complete several important series have been secured. Sixty volumes have been bound. Not only have important additions been made by exchange, but some works on Entomology and Geology have been purchased, thus providing students in these branches with much-needed text books. The librarian recommends the publication of a catalogue.

Publications.

Bulletin XVI, which was issued in the month of August, differs from its predecessors in the size of the page, which has been enlarged. It was necessary to print an edition of 600 copies, instead of 500 as formerly, in order to meet the demands made upon it by a large and growing exchange list and membership.

The articles are valuable and have been read with interest. Dr. L. W. Bailey, S. W. Kain, John Moser, Dr. Matthew, Dr. W. F. Ganong, and Dr. Philip Cox, each contributed.

The reports of the Fredericton Natural History Society, and the Kings County Natural History Society, find a place in our Proceedings.

Museum.

A new insect cabinet has been obtained, and good work has been done by expert entomologists in naming specimens.

Among important accessions in other branches, the donations of Dr. Reynold J. Kirkland, of Grand Rapids, Michigan, Miss Warner, and Geoffrey Stead, C. E., are worthy of special notice.

Lectures and Essays.

Nine regular meetings were held at which the following papers were read:

1898.

Feb'y 2. (1) Study of Insects, by Wm. McIntosh.

(2) Note on Turtles' Nests, by Henry F. Perkins.

March 1. (1) New Brunswick Thunder Storms in 1897, by S. W. Kain. (Published in U. S. *Weather Review*, pp. 105-106, March 1898.)

(2) Gun Reports at Grand Manan, by W. B. McLaughlin.

Published in U. S. *Weather Review*, March 1898, together with articles by Prof. W. F. Ganong and others on the same subject.

This reprint reviewed in *Nature*, p. 353, August 11, 1898.

Nature, for June 9, 1898, p. 130; also gives synopsis of studies by an Italian on similar sounds in Umbria.

(3) Mean Sea-level at St. John, by E. T. P. Shewen, C. E. (Published in Bulletin XVI, p. 78, 1898).

(4) Physiography of the Lepreau Basin, by Prof. W. F. Ganong.

(5) Note on Crayfish in New Brunswick, by Prof. W. F. Ganong.

(6) Note on Marine Invertebrates of the Western part of Bay de Chaleur, by Prof. W. F. Ganong.

April 5. (1) Biographical Sketch of late R. Foulis, C. E., by Percy G. Hall. (Published in *New Brunswick Magazine*, Vol. I, pp. 247-256, 1898.

(2) Habits of Birds, by A. Gordon Leavitt.

May 3. Notes on the Trees of New Brunswick, by W. S. Butler.

June 7. (1) Report of Delegate to the Royal Society, by W. J. Wilson.

(2) Early Forms of Decoration and Art, by Miss Jack.

Oct. 4. (1) Geological and Topographical Features of Newfoundland, by Dr. Geo. F. Matthew.

(2) Notes on Some Phenomena in Grand Manan, by D. I. W. McLaughlin. (Published in St. John *Globe*, October 6th, 1898).

Describes remarkable sound heard at midnight, September 15th, 1898; auroral display on evening of September 17th; very heavy ground swell on September 18th. Attributes the heavy swell to hurricane which swept over West Indies on September 10th.

Prof. A. W. Duff, among letters to the editor in *Nature*, Vol. LIX, pp. 247-248, January 12th, 1899, refers to this heavy ground swell in explaining the nature and cause of secondary undulations in the Bay of Fundy and elsewhere.

(3) Note on Lack and Cost of a Topographical Survey of New Brunswick, by Prof. W. F. Ganong.

Nov. 1. (1) Note upon Natural Pavements and their possible misinterpretation in Archæology, by Prof. W. F. Ganong.

(2) Note, Attempts at Oyster Culture in Passamaquoddy Bay, by Prof. W. F. Ganong.

1898.

Nov. 1. (3) Bird Enemies, Natural and Unnatural; and why Birds should be Protected, by A. Gordon Leavitt.

Dec 6. (1) New Brunswick Butterflies, by W. McIntosh.

(2) Note on the Dip of the Magnetic Needle in New Brunswick, by Prof. A. Wilmer Duff.

(3) Preliminary Outline for a Study of the Precise Factors Determining the Features of New Brunswick Vegetation, by Prof. W. F. Ganong.

(4) Note on the Nature of the Mud in our many Mud Lakes, by Prof. W. F. Ganong.

1899.

Jan. 3. (1) Note, Upon Biological Opportunity in New Brunswick, by Prof. W. F. Ganong.

(2) Note, Upon a Current Error as to the Location of (Nictor) Bald Mountain, Tobique, by Prof. W. F. Ganong.

(3) Address, Economic and Social Conditions in Newfoundland, by W. Frank Hatheway.

Elementary Series.

1898.

Jan. 11, 25. Elementary Talks and Laboratory Work on Bog and Pond Deposits, directed by Dr. Geo. F. Matthew.

Feb. 8, 15, 22. Talks and Laboratory Work on Plants, directed by President Geo. U. Hay.

March 15, 22. Talks and Laboratory Work on Insects, directed by Wm. McIntosh.

March 29. Notes on Batrachians and Reptiles of New Brunswick, by Chas. F. B. Rowe.

April 12, 19. Talks and Laboratory Work on Birds, directed by A. Gordon Leavitt.

The Associates' Afternoon Series.

The weekly lecture, held on Thursday afternoon of each week, enjoyed considerable popularity. Papers were read by Miss Jack, Miss Eleanor Robinson, Miss Frances Murray, Miss Christine D. Matthew, Dr. Geo. F. Matthew, Robert Matthew, and S. W. Kain.

General.

We have pleasure in announcing the complete success of the assistant librarian scheme. The requisite number of new members was found, and their fees amply covered all expenses. The assistant has been at her post on Tuesday, Thursday and Saturday afternoons, performing her duties in a manner that has given entire satisfaction. Nor have her duties been light, for a great increase of visitors has resulted. Formerly about one hundred and fifty persons registered in the course of a year; during the past year over eleven hundred

names are entered, and as many as fifty persons (in this case mostly school children) have examined the collections in a single afternoon. No better argument for the continuance of the plan of more frequently opening the museum to the public could be produced. The conversazione held on the evening of June 29th, in honor of the members of the Teachers' Institute, was a very pleasant affair, in spite of the fact that the rooms were somewhat crowded. Addresses were delivered by His Honor the Lieutenant Governor, His Worship Mayor Sears, and others, after which the guests circulated through the museum, finding much that was interesting and curious.

By the generosity of a well-known citizen the Society was enabled to offer prizes for the best collections of insects, weeds and fungi. Circulars setting forth the conditions of the competitions were distributed throughout the province. Prizes were awarded for six collections,—four for insects, two for weeds.

Such competitions we believe to be very useful in stimulating the study of natural history, and we trust that we may again be permitted to offer such inducements to the young naturalists of our province.

At the request of the Exhibition Association the Society occupied considerable space alongside of the exhibit of the Provincial Government. The prize collections of plants were displayed on this occasion, together with a lot of ores and other minerals and constituted an attractive feature of the fair.

The Committee on Economics has continued to urge upon the Dominion Government the desirability of erecting a plant for the creosoting of timber at St. John. We believe that the government is alive to the wisdom of such a course, and hope that they will soon take steps in the matter.

Our thanks are due to the editors of the daily papers of St. John for the free insertion of notices and reports of meeting, and to the ladies and gentlemen who contributed to the various courses of lectures.

In the past year the Society has gained in membership, the lecture courses have been more varied and extensive, the additions to the museum and library have been important, and many hundred visitors have been attracted to the museum, including many of our young people, in some of whom has doubtless been awakened an interest in natural history, and from whom the ranks of our Society may in the future be recruited.

Respectfully submitted,

PERCY G. HALL,
Secretary to Council.

Natural History Rooms, Market Building,
January 17th, 1899.

FREDERICTON NATURAL HISTORY SOCIETY.

(Instituted February 2nd, 1895.)

The officers for the current year are:

L. W. Bailey, Ph. D., - - - - - - - -	*President.*
G. N. Babbitt, - - - - - - - - - - -	*Vice-President.*
John Brittain, - - - - - - - - - - -	*Secretary.*
B. C. Foster, M. A., - - - - - - - - -	*Treasurer.*
H. H. Hagerman, B. A., - - - - - - -	*Curator.*

Eight regular meetings were held during the year, at which papers were read as follows:

1898.	
Mar. 21.	Radiate Animals, by Dr. Bailey.
Apr. 18.	Electricity and the X-rays, by Dr. Bailey and Mr. G. N. Babbitt.
May 16.	Jottings by the Way, by Very Reverend Dean Partridge.
June 20.	Under the Southern Cross, by Mr. H. E. West.
Oct. 17.	Coal, by Dr. Bailey.
Nov. 21.	The Woodpeckers of New Brunswick, by W. H. Moore.
	Birds and their Ways, by John Brittain.
Dec. 19.	The Mountain Systems of North America, by Dr. Bailey.
1899.	
Jan. 16.	Electricity, by H. H. Hagerman, B. A.

Several donations have been made to the museum during the year.

JOHN BRITTAIN,
Secretary.

KINGS COUNTY NATURAL HISTORY SOCIETY.

(Organized at Sussex, Kings County, N. B., October 2nd, 1897.)

The society had for president Mr. Robert King, A. B., until September 3rd, 1898, when he resigned on account of moving to Montreal, and Inspector R. P. Steeves, A. B., was elected president.

During the year closed October 1st, 1898, the society held ten regular meetings.

The work of the year has been along the lines of collecting specimens and reading of papers on scientific subjects. There have been added to the scientific collections, eighty specimens in the five branches, as follows: Geology and Mineralogy, 24; Entomology, 20; Ornithology, 16; Zoology, 4; and Botany, 16.

During the year the following papers were read before the society:

1897.
Dec. 4. Sea Plants in the Interior of New Brunswick, by R. King, A. B.
1898.
Feb. 5. Plaster of Paris Methods in Blow Pipe Analysis, by R. King, A. B.
March 5. The Chicadees, by H. J. Perry.
5. A Canoe Voyage on the Restigouche, by G. U. Hay.
April 2. Our Winter Birds, by W. N. Biggar.
2. An Ice Age, by W. A. Alward, A. B.
May 7. The Structure and Characteristics of Birds, by Dr. S. H. Langstroth.
7. Spring Birds, by W. N. Biggar.
June 4. Spring Flowers of Kings County, by Milton Price.
Sept. 4. Characteristics of the Frog, by Annie White.

The society has a registry department, with four divisions, for recording observations in—Migrating of Birds, Leafing and Flowering of Plants, Changes in Weather, and Observations in Insect Life. Each division is under the management of an officer elected by the society.

During the year the society received as donations a number of books from members, a set of Bulletins and Bye-Laws from the N. B. N. H. Society, and a fine miscroscope from Mr. E. A. Charters.

Regular meetings are held in the Oddfellows' Hall the 1st Saturday in each month, a 8 o'clock p. m.

WM. N. BIGGAR,

Secretary.

THE NATURAL HISTORY AND ANTIQUARIAN SOCIETY OF PRINCE EDWARD ISLAND.

On the 28th March, 1889, Donald Montgomery, Superintendent of Education in the Province, invited those interested to attend a meeting in his office for the purpose of forming a Natural History Society. Six gentlemen attended, but from this small beginning a vigorous society developed, and continued its active co-operative work until the winter of 1891-92, when it decided to discontinue its regular public meetings lest they should in any way interfere with a course of lectures upon Botany, being delivered under the auspices of the local University Extension authorities, by Mr. Francis Bain, whose lamentable death, in November 1894, was a great loss to the Society in that it robbed it of its most valuable member and most frequent contributor to its lecture course. Still, while no public meetings were held, the Society continued to exist, and it was felt that it would be desirable to widen its scope, and thereby lighten the work of the few already over-busy members upon whom would devolve the task of preparing papers for the public meetings. Accordingly at a meeting held January 10th, of this year, the Society was re-organized with above name, having added to its work the study of Provincial antiquities.

The following are the officers:

John Newson, Esq., - - - - - - - - - - *President.*
John MacSwain, Esq., - - - - - - - - - *Vice-President.*
Lawrence W. Watson, M. A., - - - - - - *Secy-Treas.*
The above and Miss Peppy, Messrs. J. M. Duncan,
J. D. Seaman and W. J. Bulman, - - *Executive.*

The new society hopes to publish a periodical Bulletin (probably quarterly) and desires exchanges, which may be addressed to the Secretary at Charlottetown, P. E. I.

To give an idea of the work already done, we append a list of papers read before the original society.

1889.	
July 2.	The Study of Island Botany. Francis Bain.
Sept. 4.	The Ferns of P. E. Island. John MacSwain.
25.	The Asters of P. E. Island. Francis Bain.
Nov. 14.	Some Enquiry into the Ethnology of the Island. Col. J. Hunter-Duvar.
1890.	
April 20.	The Red Sand-Stone of P. E. Island. Francis Bain.
May 12.	Carnivorous Plants. Lawrence W. Watson, M. A.
June 9.	The Animals of P. E. Island at the Beginning of the Nineteenth Century. Geo. F. Owen.
July 14.	Our Forest Trees. Hon. David Laird, P. C. (President).
1891.	
	The Proposed Subway to the Mainland. Francis Bain.
Feb. 2.	Insect Intelligence and Instinct. T. Leeming, M. D.
23.	The Diseases of the Potato. John MacSwain.
Mar. 12.	Plants and their Uses. Rev. W. Hamlin, B. A.
Apr. 5.	Plant Food and How they Obtain It. Prof. Schuttleworth.
13.	The Life History of the Butterfly. L. W. Watson, M. A.

The Society has published several lists of plants of the province by Messrs. MacSwain and Bain, which will likely appear, revised or supplemented, in the proposed Bulletin of the Society.

DONATIONS TO THE LIBRARY, 1898.

Donor's Name.	Residence.	Work.
Royal Geographical Society	London	Journal.
Trustees British Museum	do	Guides.
Royal Society	do	Proceedings.
Royal Colonial Institute	do	Journal.
Geological Society	do	Abs. of Proceedings.
Director Royal Gardens	Kew	Bulletins.
Manchester Geological Society	Manchester	Proceed. and Trans.
Biological Society	Liverpool	do
Liverpool Geological Society	do	do
Marine Biological Association	Plymouth	Journal.
Naturalists' Field Club	Belfast	Report.
Philosophical and Literary Society	Leeds	78th Report.
Natural History Society	Glasgow	Proceedings.
Royal Society of Canada	Ottawa	Proceed. and Trans.
Ottawa Field Naturalists' Club	do	Ottawa Naturalist.
Department Inland Revenue	do	Bulletins.
Department of Agriculture	do	Census Reports.
Experimental Farms	do	Bulletins.
Literary and Scientific Society	do	Transactions.
Entomological Society of Ontario	London, Ont	Can. Entomologist.
Hamilton Association	Hamilton	Journal.
Natural History Society	Montreal	Can. Record of Scien.
Historical and Scientific Society of Manitoba	Winnipeg	Report.
Nova Scotia Institute of Natural Sciences	Halifax	Proceedings.
Canadian Institute	Toronto	Transactions.
Toronto Public Library	do	Report.
Astronomical and Physical Society	do	Transactions.
R. F. Stupart	do	Weather Review.
Government of British Columbia	Victoria	Mining Record.
Dr. Geo. F. Matthew	St. John, N. B.	Pamphlets.
Samuel W. Kain	do	Six Volumes.
New Brunswick Historical Society	do	Collections.
G. U. Hay	do	3 vols. His. Mank'd.
Scientific Association of Trinidad	Port of Spain	Proceedings.
Australian Museum	Sydney, N. S. W.	Report.
Australian Association for Advancement of Science	do	do
Linnæan Society of N. S. W	Elizabeth Bay	Proceedings.
New Zealand Institute	Wellington, N. Z.	Proceed. and Trans.
U. S. Bureau of Ethnology	Washington	Reports.
U. S. Geological Survey	do	Reports and Bulletins
U. S. Fish Commission	do	do
U. S. National Museum	do	Reports and Proceed.
U. S. Dep't. of Agriculture (Botanical Division)	do	Bulletins.
U. S. Coast and Geodetic Survey	do	Report.
U. S. Weather Bureau	do	Weather Review.
Smithsonian Institution	do	Report.
University of California	Berkeley, Cal	Bulletins.
Cornell University	Ithaca, N. Y.	Bulletins.
John Hopkins University	Baltimore	Circulars.
Leland Stanford, Jr., University	Palo Alto, Cal.	Proceedings.
Boston Society of Natural History	Boston	do.
Essex Institute	Salem	Transactions.
Maine State College	Orono	Bulletins.
Society of Natural History	Buffalo	do
Academy of Natural Science	Davenport, Iowa	Proceedings, 6 vols.
Geological Survey of Iowa	Des Moines	Report. Vol. VII.
Iowa Academy of Sciences	do	Proceedings.
New York Academy of Sciences	New York	Journal
New York Microscopical Society	do	Abstract of Proceed.
Linnæan Society of New York	do	Report.

DONATIONS TO THE LIBRARY—*Continued.*

DONOR'S NAME.	RESIDENCE.	WORK.
American Museum of Natural History	New York	Bulletin.
New York Public Library	do	Bulletins.
University of New York	Albany	Museum Report.
Colgate University	Hamilton	Circulars.
Natural Science Association of Staten Island	New Brighton	Proceedings.
Rochester Academy of Natural Sciences	Rochester, N. Y.	do
Society of Natural History	Cincinnati	do
Academy of Natural Science	Philadelphia.	do
Minnesota Academy of Natural Sciences	Minneapolis	Bulletins.
Texas Academy of Science	Austin	Transactions.
Indiana Academy of Natural Sciences	Indianapolis	Proceedings.
California Academy of Sciences	San Francisco	do
Colorado Scientific Society	Denver	Transactions.
C G. Lloyd	Cincinnati	Plates.
Missouri Botanical Gardens	St. Louis	Report.
Field Columbian Museum	Chicago	Publications.
Societe Scientifique du Chili	Santiago	Actes.
National Museum	Montevideo	Annales.
Royal Academy of Science	Stockholm	Proceedings.
Comite Geologique du Russie	St. Petersburg	Memoirs.
Imperial Academy of Sciences	do	Bulletins.
Royal Academy	Barcelona	do
Ch. Janet	Paris	Pamphlets (8).
Institute of Geology	Mexico	Bulletins.
Geological Institute	Upsala	do
Royal Society of Belgium	Brussels	do
G. O. Sars, Esq	Christiania	Fauna Norvegiæ.

PURCHASED.

Insect Life. Vols. I–IV.

Insects of New York. Vols. I and II.

Manual of Paleontology, by Alleyne Nicholson. Vols. I and II.

A Text Book of Entomology, by Dr. A. S. Packard.

Manual of Entomology, by Comstock.

DONATIONS TO THE MUSEUM, 1898.

DATE.	DONOR'S NAME AND DESCRIPTION OF ARTICLE.
March	UNITED STATES NATIONAL MUSEUM. 17 Fossil Plants of the Richmond (Va.) coal field, ("Rhœtic"); 40 Fossil Plants of the Potomac formation.
	MR. ALFRED MORRISEY. Japanese Bird Skins.
	MR. GEO. E. FAIRWEATHER. Two St. John papers of the year 1789.
April	MR. JAS. PATTERSON. Number of Marine Forms preserved in alcohol.
	DR. R. J. KIRKLAND, Grand Rapids, Mich. 250 Fresh Water and Land Shells.
May	PROF. JAS. FOWLER, Kingston, Ont. Number of mounted plants.
June	E. T. P. SHEWEN, C. E. Specimens of polished marble from Bras D'Or, C. B.
	MR. A. H. HANINGTON. Cocoon of the Emperor Moth.
October	MRS. JAS. WARNER. Collection of Shells, Egg cases of Conch Shell, Spawn of Ray, from Gulf of Mexico.
	MISS AGNES L. WARNER. Collection of New Brunswick plants.
	MR. W. FRANK HATHEWAY. Stone Gouge, from Random Sound, Newfoundland.
	MR. SAMUEL LYONS. Stone Gouge, from Westfield Beach.

DONATIONS TO THE MUSEUM.—*Continued.*

Date.	Donor's Name and Description of Article.
October	GEOFFREY STEAD, C. E. Geological specimens from New York.
Nov.	MR. A. GORDON LEAVITT. Black-backed Gull; Ichneumon Fly.
	MR. C. G. KNOTT. Diseased root of Viburnum cassinoides.
	MR. ROBERT MURDOCH. Diatomaceous Earth.
Dec.	MRS. PERCY OWEN-JONES. Granite ball, from Pot Hole, Peterboro, Ont.
	MISS HARRIET PETERS. Slate from Cape Town, South Africa (near home of Cecil Rhodes).
	DR. BABBITT. Stone Pestle; Skin roller and Arrow Heads, from Oregon.
	MISS NANNARY. Ink-stand of California minerals, Bark and wood of big redwood tree, California shells.

DONATIONS TO THE FUNDS, 1898.

James Manchester, Esq. (for Exhibition Prizes)	$100 00
Anonymous	37 00
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BULLETIN

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St. John, N. B.. June, 1899.]

ARTICLE I.

PRELIMINARY NOTICE OF THE ETCHEMINIAN FAUNA OF NEWFOUNDLAND.

BY GEO. F. MATTHEW, D. SC., LL.D.

Read February 7, 1899.

For comparison with the known forms of the Etcheminian terrane in New Brunswick and as a guide to other species which may be discovered in it, the author describes here briefly, and figures the species which have been found in the Etcheminian rocks of Newfoundland.

BRACHIOPODA.

OBOLELLA c. f. CHROMATICA, Billings. Pl. I., fig. 1.

See *O. chromatica*, Bill., Palæoz. Foss., vol. i., p. 7, fig. 7, *a.* to *d.*

A small Obolella, resembling the above species, was met with. The surface is granulated, but shows undulations of growth and faint obscure radiating lines.

KUTORGINA GRANULATA, n. sp. Pl. I., fig. 2, *a.* to *d.*

Another little shell, but with a straight hinge line, occurs. The surface is minutely granulated; concentric striæ and faint radial lines are visible. *Size*—Length, 4 mm; width, 6 mm; depth of ventral valve, 1½ mm.

This species is smaller than *K. cingulata* and differs in ornamentation. It is about the size of *K. pannula*, but has not the diagonal cancellation of that species.

GASTEROPODA.

SCENELLA c. f. RETICULATA, Billings.

c. f. *Scenella reticulata*, Bill. Palæoz. Foss., vol. ii., pt. i., p. 77, (no figure).

Some shells were observed which appear to be of this species of Billings. The ornamentation is of sharp thread-like radiating ridges, which, without break, cross over fine striæ of growth. *Size* of the aperture, 7x9 mm.

SCENELLA c. f. RETUSA, Ford.

Scenella c. f. *retusa*, Ford. Am. Jour. Sci., 3 ser., vol. v., p. 213 figs. 2 *and b* (page 214).

Another species occurs, smaller than *S. reticulata*, and distinguished by its ornamentation. The radiating ridges are broader than in this species and both radiating and concentric ridges are obscured by a more distinct granulation of the surface.

RANDOMIA, n. gen.

This genus does not differ in form from Palæacmæa, but it is characterized by strong radiating ridges, which cross the cencentric ridges and prominent undulations of growth, that mark the shell. Mr. E. O Ulrich says that the species of Palæacmæa have only concentric lines

RANDOMIA AURORÆ, n. sp. Pl. I., figs. 3 *a* to *c*.

This is one of the most characteristic species of the Etcheminian; and a species, probably the same, occurs in the St. John Basin of Eopalæozoic rocks. The surface is marked by very fine, sharply raised lines, radiating from the apex toward the margin; about six are found in the space of one millimetre. *Size*—Opening of the shell 20x25 mm.; height 11 mm.

The very prominent ridges, straighter dorsal line, and fine radiating striæ distinguish this species from *Stenotheca (?) rugosa* and *S. (?) paupera*, Bill.

PARMOPHORELLA (?) PAUPERA, Bill. sp.

Stenotheca paupera, Bill. Pal. Foss., vol. ii., pt. i., p. 77 (no figure).

A few examples occur which agree with this species. The shells are compressed laterally, indicating that it had a narrow, oval aperture.

PLATYCERAS TRANSVERSUM, n. sp. Pl. I. figs. 4 *a* and *b*.

This is one of a group of three species of small gasteropods, occasionally met with at Smith Sound. They are found buried in the calcareous mud of the upper limestone, and also within the tubes of Hyolithes, etc., where they probably concealed themselves after the death of the animals which formed those tubes.

The surface of all those species is minutely granular, and in none does the curve make a complete whorl, but the umbo projects too far to allow the shell to be classed with Palæacmæa or Parmophorella. *P. transversum* is considerably larger than the other two, and is distinguished by its fine, closely set growth lines.

PLATYCERAS RADIATUM, n. sp. Pl. I., figs. 5 *a* and *b*.

This is proportionately a longer species with more projecting umbo. It is distinguished by about a dozen fine, narrow, sharp ribs on the dorsum, radiating from the umbo.

This differs from any described Cambrian or Ordovician species. It approaches the genus Heliconopsis, Ulrich and Scofield; but its strongly curved back and projecting umbo separate it.

PLATYCERAS CYMBULA, n. sp. Pl. I., figs. 6 *a* and *b*.

Distinguished from the preceding by its smooth surface, and from the first by its sub-carinate dorsum, and less concave slopes in the anterior region.

LAMELLIBRANCHIATA.

MODIOLOPSIS THECOIDES, n. sp. Pl. I., figs. 7, *a* to *c*.

Only the right valve is known; it is remarkable for its long, narrow shape and ear-like anterior end. When this is concealed, the shell is easily mistaken for a Hyolithes, the form of the posterior end and the sculpture of the surface, being like the dorsal side of a tube of that genus. The shell is about 9 mm. long and 4 mm. wide.

ANNELIDA.

UROTHECA, n. gen.

This genus based on chitinous tubes from the Etcheminian and Cambrian is described in an article to be communicated to the Royal Society of Canada, May 1899.

UROTHECA PERVETUS, n. sp. Pl. I., fig. 8.

Only the distal end of this tube is known, and that pressed flat in the stone so that the form of the orifice is not seen. *Size*—Length of the part preserved 35 mm., width 3½ mm.; rate of tapering, 1 in 17 mm.

HELENIA GRANULATA, n. sp. Pl. II., figs. 7, *a* to *e*.

Small, much flattened, curved tubes, the curve not in one plane, but the tube somewhat twisted. The tubes enlarge towards the aperture so that in 10 mm. of the length the width is doubled. Width of the orifice 2½ mm. Surface minutely granulated.

The form and curve of the fragments of these tubes cause them to resemble those of the genal and pleural spines of trilobites, but we have found nothing resembling the cheeks or head of trilobites in the bed where these fragments are found.

HYOLITHELLUS MICANS, Billings, (pars). Pl. II., figs. 1., *a* to *d*.

These appear to be much smaller than the limit of size assigned by Mr. Billings for his species. But I surmise that objects similar to these have been included under his name. *Size*—The longest are 20 mm. with a width of 1 mm. The surface, though shining, is not quite smooth, but is minutely granulated. These objects appear to be clustered in the shale, as though they were gregarious, or were attachments of larger organisms.

HYOLITHELLUS (?) FLEXUOSUS, n. sp. Pl. I., fig. 9.

A small slender tube of which the proximal end is very slender, straight and hyaline. This enlarges somewhat abruptly into a terete, opaque tube, which is curved in one or more planes. Rate of taper of the known part 1 in 20 mm.

This species differs from *Hyolithes lævigatus*, Linrs., (Torellella, Holm.) in its circular form and calcareous substance.

The slender, cylindrical, hyaline tube in which this species begins was possibly membranaceous; if chitinous it was extremely thin.

COLEOIDES TYPICALIS, Walc. Pl. II., fig. 2.

Objects which appear to agree in all respects with this species are common with Hyolithellus, from which some can hardly be distinguished; they have a length of 10 mm. and a width of 1½ mm.

ORTHOTHECA PUGIO, n. sp. Pl. II., fig. 4 *a* to *d*.

An elongated, thick shelled species having the tube somewhat flattened on the dorsal side, and arched longitudinally toward the ventral side. The known part of the tube is about 27 mm. long, with an orifice of 6 mm. The whole length would be about 40 mm. if the shell preserved its taper and were not decollated.

This species is like *Hyolithes communis*, Bill, but has no "dorsal lip." From *O. DeGeeri*, of the Swedish Cambrian, it differs in its rounded dorsal side and granulated surface. *O. Johnstrupi*, of the same country, has a more slender form and different sculpturing.

ORTHOTHECA SICA, n. sp. Pl. II., figs. 5, *a* to *e*.

This species which is of about the same size as *O. pugio*, may be distinguished by its smoother surface, more triangular section and more distinct surface striæ.

MUTATION. Pl. II., figs. 6, *a* and *b*.

This in place of a gradually rounded ventral side shows a flattening of the middle quarter of that side. In this it approaches *H. quadricostatus* Shaler and Fœrste, of the Attleboro fauna, but is a true Orthotheca, while the latter by its form is a Hyolithes.

ORTHOTHECA STILETTO. Pl. II, figs. 3, *a* and *b*.

A small, slender, straight species, with a very tenuous tube. It has a concave dorsal side, and a rounded, convex ventral side. Rate of tapering about 1 in 8. The dorsal side has fine, closely set striæ of growth just visible with a strong lens.

This species is near *O. affinis*, Holm, of the Paradoxides beds of Sweden, but is not half the diameter and has a more elongate form.

ORTHOTHECA BAYONET, n. sp. Pl. III. fig 1 *a* to *f*.

Tube very thin and with concave slopes on three sides, two of which are ventral. The dorsal side is concave in the middle and convex towards the angles. Each ventral slope is convex toward the middle of the ventral side and concave toward the dorsal edge. Longitudinally the tube curves toward the ventral side, especially toward the apex.

Sculpture.—The outer surface is finely granulated, and traversed by fine transverse striæ.

This tube was very fragile and is found in fragments, of which the largest indicates an aperture of 8 mm. Taper of the tube 1 in 5.

This species differs from *Hyolithes Americanus* in the absence of a lip, and in having the lateral angles more acute than the median angle of the ventral side. It differs from all Orthothecæ described by Walcott (under Hyolithes) in its angular form. It differs from all those described by Holm in the acuteness of the lateral angles, and by the concave form of the ventral slopes near those angles.

This form of Orthotheca seems not to have survived the Etcheminian time, as no similar one is found in the Cambrian.

HYOLITHES EXCELLENS, Bill. Pl. III., figs. 3, *a* to *i*.

This is the leading species of the Etcheminian fauna of Smith Sound. It is a true Hyolithes of advanced type, in which a part of the ventral surface has passed over to the dorsal side. It thus belongs to the "*Magnidorsati*" section of G. Holm, which this author considers the higher section of Hyolithes, sens. strict. In *H. excellens* the proximal part of the tube has a more triangular section than the distal, and this is seen to be due to the two sides of the tube here possessing their original integrity of form, and no portion of the ventral has passed over to the dorsal side. Hence this species at first was among the Equidorsati, but in growing to maturity became a Magnidorsatus.

HYOLITHES RUGOSUS, n. sp. Pl. III. figs. 4, *a* and *b*.

A small, slender species, having the dorsal side flatly rounded, and gently curved towards the ventral side longitudinally.

The ventral side is marked by prominent transverse ribs, which are closely set on the lower part of the tube, but in the upper fifth are more distant. Surface minutely granulated. Length 11 mm.; width about 3½ mm.

Mr. Walcott has described an object similar to this, but smaller, as *Hyolithellus micans*, var. *rugosa*; it differs in having a longitudinal striation between the ridges of growth, where this species has only a granular surface.

CRUSTACEA.

APTYCHOPSIS TERRANOVICUS. Pl. III., fig. 5

Each valve of this little crustacean has an oval lenticular form with the widest part one-third from the anterior end. The hinge has

a strong fold which is more than two-thirds of the whole length of the shield. The lower and posterior border has a distinct marginal fold. The front border is angulated, but no rostral piece is known.

mut. ARCUATA. Pl. III., fig. 6.

This form is somewhat smaller, is rounded in front, and the shape is more elongate.

The surface in these little shells is granulated and there are traces of concentric grooving. The largest is about 3½x2 mm., the mutation about 3x1½ mm

SUMMARY.

The peculiarities of this fauna as distinguished from the Cambrian are the following :

1. Great preponderance of the tube worms (*Hyolithidæ*, etc).
2. Absence or rarity of trilobites.
3. Minuteness of the Gasteropods except Capulidæ.
4. Minuteness of the Brachiopods.
5. Minuteness of the Crustaceans.

The two special types of the Etcheminian fauna are, among the Hyolithidæ *Orthotheca bayonet*, and among the Gasteropoda *Randomia Auroræ*. The minuteness of the Lamellibanchs is not peculiar to the Etcheminian as the Cambrian species are not much larger.

DESCRIPTION OF THE PLATES.

PLATE I.

FIG. 1. *Obolella* c. f. *chromatica*, Bill. Ventral valve, mag. $\frac{3}{1}$. See p. 189.

FIG. 2. *Kutorgina granulata*, n. sp. *a* Ventral valve; —*b* Dorsal valve; both mag. $\frac{3}{1}$; —*c* Dorsal (?) mould of, —— *d* Ventral, hinge seen from behind. Both mag. $\frac{5}{1}$. See p. 189.

FIG. 3. *Randomia Auroræ*, n. gen. et sp. *a* Side view, restored from two examples; —*b* Same seen from above; —*c* Smaller entire shell. All natural size. See p. 190.

FIG. 4. *Platyceras transversum*, n. sp. *a* Side view; —*b* Same seen from above. Mag. $\frac{3}{1}$. See page p. 191.

FIG. 5. *Platyceras radiatum*, n. sp. *a* Side view; —*b* Seen from above. Mag. $\frac{3}{1}$. See p. 191.

FIG. 6. *Platyceras cymbula*, n. sp. *a* Side view; —*b* Seen from above. Mag. $\frac{4}{1}$. See p. 191.

FIG. 7. *Modiolopsis thecoides*, n. sp. *a* Interior of the right valve;— *b* Section near the hinge; —*c* Section near the posterior end. All mag. $\frac{4}{1}$. See p. 191.

FIG. 8. *Urotheca pervetus*, n. sp. Distal part of the tube. Nat. size. See p. 192.

FIG 9. *Hyolithellus flexuosus*, n. sp. Proximal end of the tube. Mag. $\frac{6}{1}$ See p. 192.

PLATE II.

Fig. 1. *Hyolithellus micans*, Bill. *a* A group of paired tubes; —*b* Another group; —*c* A third group, all mag. $\frac{2}{1}$;—*d* Groups of the tubes in association with Orthotheca bayonet. Nat. size. See p. 192.

Fig. 2. *Coleoides typicalis*, Walcott. Part of a tube. Mag. $\frac{10}{1}$. See p. 192.

Fig. 3. *Orthotheca stiletto*, n. sp. *a* The tube; —*b* Section at the aperture, both mag. $\frac{4}{1}$. See p. 193.

Fig. 4. *Orthotheca pugio*, n. sp. *a* A tube decollated; —*b* Form of aperture;—*c* Section at the decollation; —*d* A smaller example, side view; —*e* An operculum, possibly of this species. All mag, $\frac{2}{1}$. See p. 193.

Fig. 5. *Orthotheca sica*, n. sp. *a* Decollated tube, ventral side; — *b* Form aperture; —*c* Another tube with more rounded angles;—*d* Form of the aperture. All mag. $\frac{2}{1}$; —*e* An operculum, possibly of this species. Mag. $\frac{2}{1}$. See p. 193.

Fig. 6 *Orthotheca sica*, quadricostate mutation; *a* Ventral view of the tube; —*b* Section at the aperture. Both mag. $\frac{2}{1}$. See p. 193.

Fig. 7. *Helenia granulata*, n. sp; *a* Side view of the tube; —*b* Front view of another tube. Both mag. $\frac{2}{1}$; —*c* Section of the second tube. Mag. $\frac{4}{1}$; —*d* Large end of a tube, mag. $\frac{2}{1}$; —*e* Section, mag. $\frac{4}{1}$. See p. 192.

Plate I

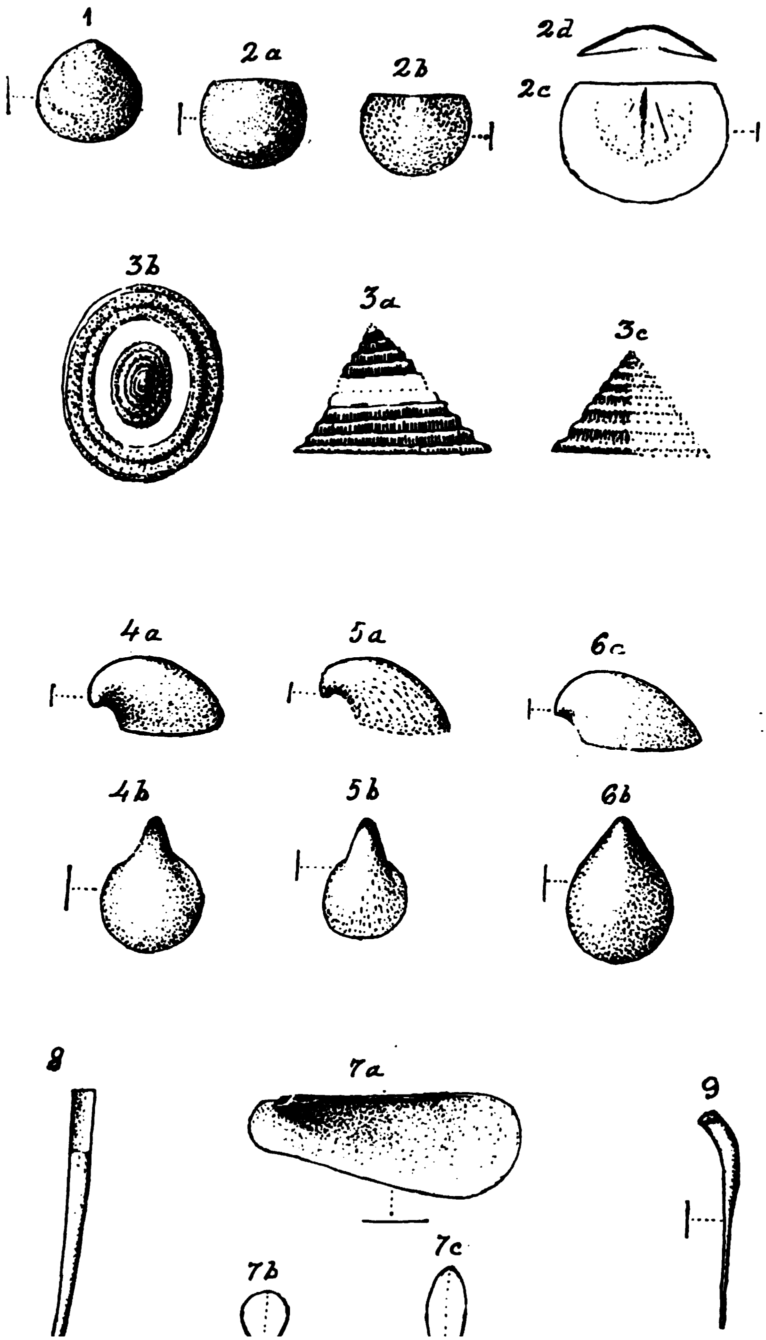


Plate II

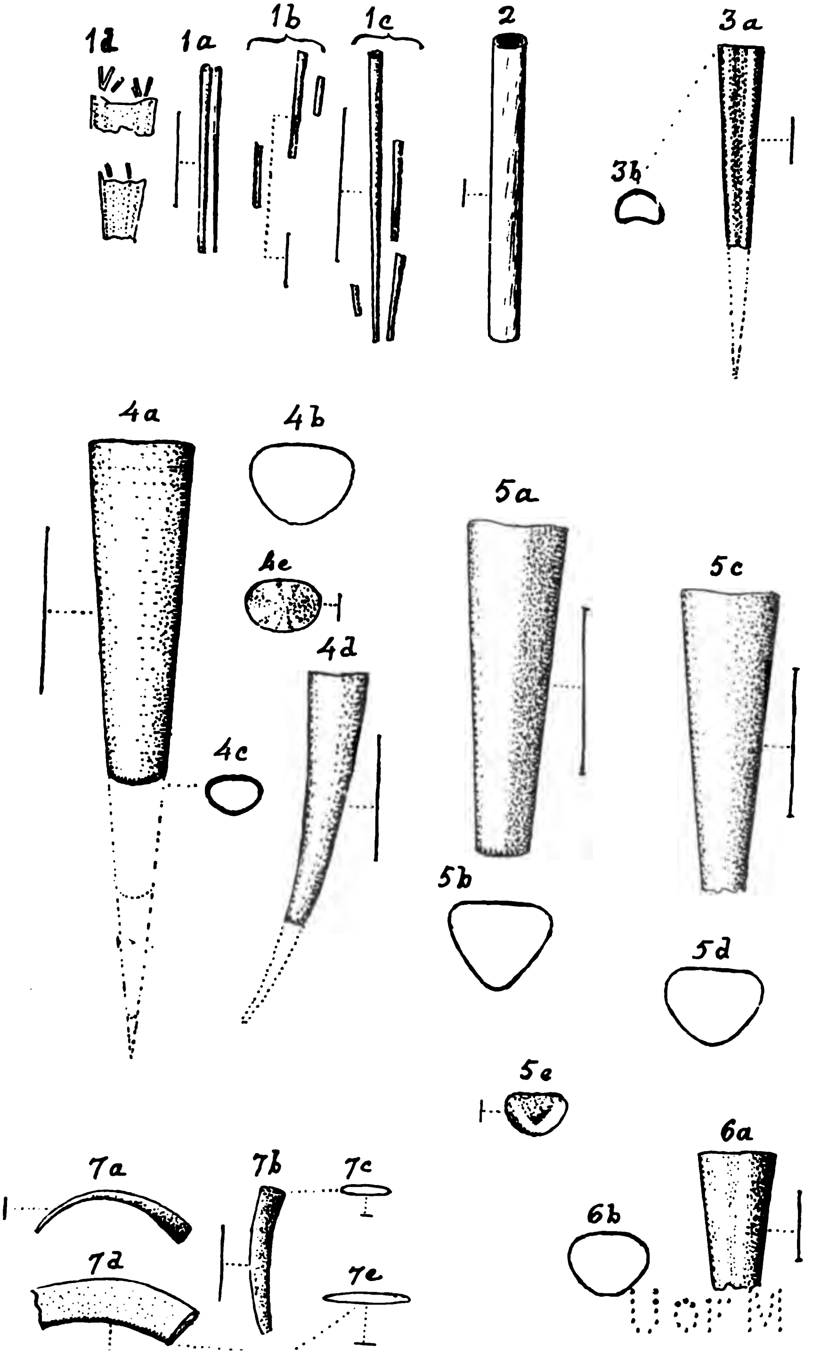


Plate III

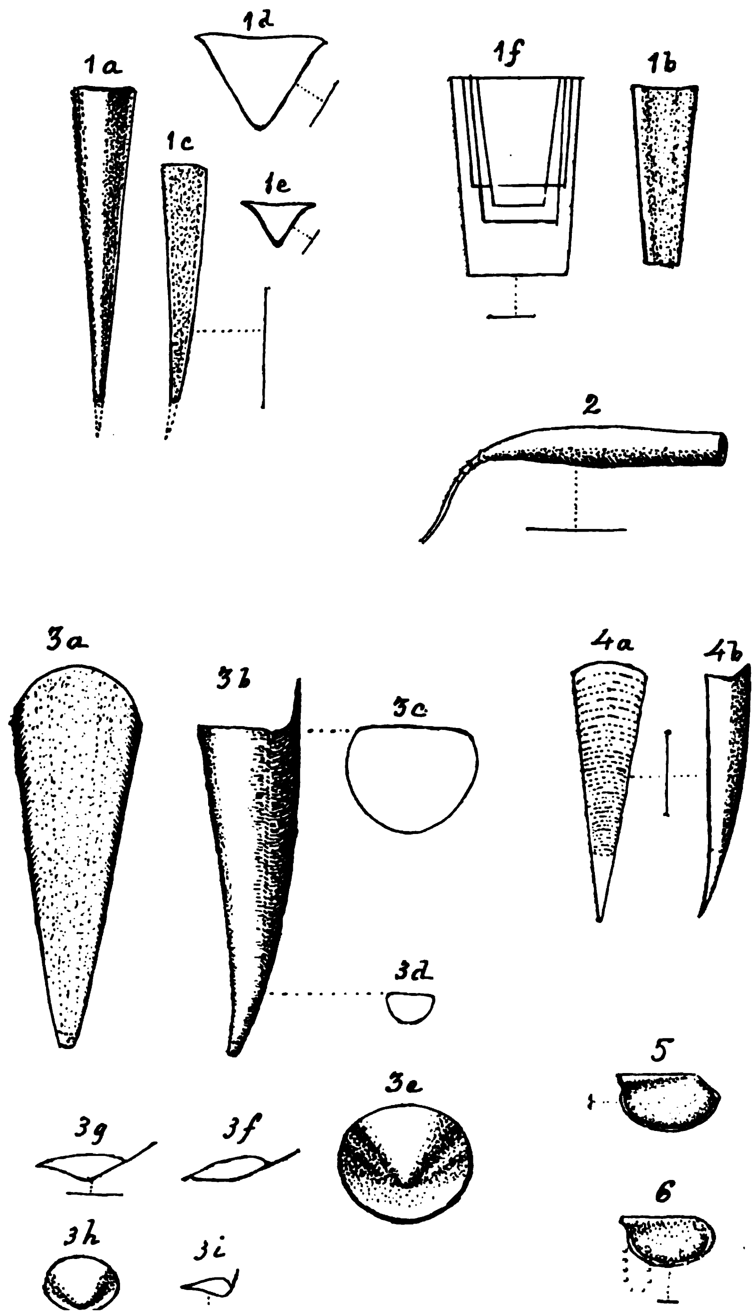


Plate III.

Fig. 1. *Orthotheca bayonet*, n. sp. *a* The tube, ventral side; —*b* A tube showing the dorsal side; both nat. size; —*c* Side view of a small example, mag. $\frac{2}{1}$; —*d* Form of the aperture of the tube; —*e* Section toward the small end, both mag. $\frac{2}{1}$; —*f* Outline of the distal end of several tubes, to show the taper; mag. $\frac{2}{1}$. See p. 193.

Fig. 2. *Urotheca*. A small species of the Mt. Stephen fauna, figured, to show the larval tube of the young worm; mag. $\frac{3}{1}$. See p. 191.

Fig. 3. *Hyolithes excellens*, Bill. *a* Dorsal side of the tube; —*b* Side view; —*c* Form of the aperture; —*d* Section near the small end; —*e* Operculum of this species; —*f* Outline of side view; all nat. size; —*g* Side view of a young opercule; —*h* A still smaller opercule, probably of this species; —*i* Side view of same, the three mag. $\frac{2}{1}$. See p. 194.

Fig. 4. *Hyolithes rugosus*, n. sp. *a* Dorsal side of tube; —*b* Side view of tube; both mag. $\frac{2}{1}$. See p. 194.

Fig. 5. *Aptychopsis terranovicus*, n. sp. Side view of right valve; mag. $\frac{4}{1}$. See p. 194.

Fig. 6. *Aptychopsis terranovicus*, mut. *arcuata*. Side view of right valve; mag. $\frac{4}{1}$. See p. 195.

P. S.— In the above article is described briefly the Etcheminian Fauna in the locality where it shows to best advantage. Those who wish to know the stratigraphical relations of the rocks which contain it, are referred to the Annals of the New York Academy of Science, Vol. XII., No. 2, pp. 41–56.

ARTICLE II.

PRELIMINARY NOTICE OF THE ETCHEMINIAN FAUNA OF CAPE BRETON.

By G. F. Matthew, LL.D., D.Sc., F.R.S.C.

(Communicated by permission of the Director of the Geological Survey of Canada, 3rd of October, 1899.)

The following brief notice of the new fauna recovered from the Etcheminian rocks of Cape Breton is presented for the information of those who are working in the oldest fossiliferous deposits; and is collateral to a similar notice of the Etcheminian fauna of Newfoundland presented to the Society in the early part of this year.

The physical conditions and history of the Etcheminian deposits in Cape Breton are very closely parallel to those in New Brunswick. In both regions there was volcanic action in districts adjoining the areas where the sediments of this age accumulated; or there were exposed areas of volcanic deposits (ashes, etc.,) from which much of the sediment was derived. This is a more noticeable condition in the Lower Etcheminian of Cape Breton, than in that of New Brunswick; but the Upper Etcheminian of both regions had a very similar physical history.

Appended to this notice (See Plate IV.) are two sections of the Cape Breton Cambrian and Etcheminian, from which the relations of the two terranes in that region will be seen, and from which it appears that the Cambrian of that island rests sometimes on the Etcheminian, and at others directly upon the older felsites and syenites which form prominent ridges of land on that island.

As regards the Cambrian it is to be noted that these sections show *no Lower Cambrian* nor have the faunas of this part of the system (Paradoxides and Protolenus) been recognized in Cape Breton. The fauna which is found in the lowest sandstones and shales above the basal conglomerate of the Cambrian, appears to be Upper Cambrian; certainly all the faunas above the latter pertain to the upper horizons,

It is therefore more reasonable to expect a discordance of strata in this region between the Cambrian and the Etcheminian than in the region of New Brunswick where the Lower Cambrian is present.

The conditions for the preservation of fossils seem to have favored more the region of Cape Breton, for there we have a fuller fauna than in New Brunswick.

Though fossils are also more abundant in the Etcheminian of Newfoundland than in the last named province, that fauna is quite dis-similar from the one in Cape Breton. This latter fauna has a facies similar to that of the Protolenus Zone in New Brunswick, if we eliminate the trilobites from the latter. In fact every genus in this new fauna has its counterpart in the Protolenus Zone; but when it comes to a comparison of species, we cannot find one that is common to the two faunas. Hence we must believe there is a greater difference in age than at first sight appears.

It is to be remarked however, that if the sequence of similar physical events were contemporary in the two regions, the most characteristic part of the known fauna of the Etcheminian in New Brunswick lies below the fossiliferous zones in Cape Breton from which came the fossils described in the following pages. Hence this fauna might be expected to show a closer relation to that of the Protolenus beds than any other Etcheminian fauna, described, especially if we regard also the similar physical conditions which environed the two faunas.

DESCRIPTION OF THE FOSSILS.

LINGULELLA GREGWA, n. sp. Pl. I., figs. 1*a* to *f*.

This species has a long acuminate beak to the ventral valve like *Lingulepis pinniformis* of a later fauna, but the dorsal valve is quite different; its central group of scars is advanced far to the front, as in Obolus, and in connection with this feature a flattened band traverses the centre of this valve; this flattened area is narrower than that of *Mickwitzia monilifera* and *Obolus major*, and it is a smaller species than the latter.

Sculpture.—The surface of the valves of this species has a dull appearance, and under the lens the ornamentation is resolved into irregular concentric beaded ridges.

Size.—Length of ventral 12 mm., width 9 mm. The dorsal valve is 3 mm. shorter than the ventral.

This species is like *Lingulella acutangulus* Roem. of the Upper Cambrian of Texas, but is larger and differs in the more acuminate apex of the ventral valve, etc.

LINGULELLA TUMIDA, n. sp. Pl. I., figs. 2*a* to *c*.

A small round, thick-shelled species, of which only the ventral valve is known. It resembles an Obolella in form, but has a corneous test, and a pedicle groove.

Sculpture.—The surface of the shell is marked by rounded concentric ridges, some of which show a beaded crest.

Size.—Length 6 mm., width 5 mm.

Lingulella Martinensis, of the Protolenus Zone, is something like this in form, but is much larger. *Lingulella Ella*, H. & W., of the Middle Cambrian of the West, is like this in size and outline, but the surface markings are finer.

We now come to two species whose reference to the genus Lingulella is doubtful, because we have not recognized the pedicle groove, and because especially as regards the second, the form, etc., is suggestive of Lingula rather than Lingulella.

LEPTOBOLUS (?) COLLICIA, n sp. Pl. I., figs. 3*a* to *e*.

A small oval species somewhat pointed in front. Margins flattened, especially in the posterior half. Remarkable for the peculiar spoutlike flexure at the front of the dorsal valve, acquired in the later stages of growth. A corresponding pair of grooves appears in the anterior part of the ventral valve. This peculiarity of form simulates the sinus of the articulate Brachiopoda.

Sculpture.—This consists of fine concentric ridges, visible only with the aid of a lens. These sometimes anastomose.

Size.– Length 10 mm., width 6 mm.

LEPTOBOLUS ATAVUS, n. sp. Pl. II., figs. 1*a* to *f*.

Shell calcareo-corneous. Ventral valve somewhat pointed behind. Hinge area very small and obscure, not more than a tenth of the length of the valve. Margins of the valves arched downward all around, except at the apex of the ventral valve. The median depression of the dorsal valve indicates that the central group of muscles are set far forward in that valve, as they are also in the ventral valve.

Sculpture.—Somewhat obscure fine concentric striæ, visible with a lens, are present on all parts of the valves. A very fine granulation also can be seen. The outer layer of the shell, which carries the ornamentation, is calcareous.

Size.—Length 5 mm., width, $3\frac{1}{2}$ mm.

This species is of about the same size and geological age as *Lingulella ferruginea*, Salter; but if Davidson's figure is correct that species had a hinge area twice as long as this. It may be further observed that Davidson has included in this species forms from much higher zones of the Cambrian (Dolgelly group, etc.), but the characters are so vague that any small oval species might be referred to *L. ferruginea.* We are subject to the dilemma of choosing between two or several species which by form and size represent *L. ferruginea*, but which by other characters are found to be distinct from each other; hence, if one is *L. ferruginea*, the others are not.

Lingulella Granvillensis, Walcott, of the New York Cambrian, is of about the same size as this, and approaches it in form, but the moulding of the interior of the dorsal valve differs.

PALÆOBOLUS, n. sub-gen.

Distinguished from Obolus proper by the close approximation of the vascular trunks, as shown by their impression on the ventral valve, and by the forward direction of its branches. The callus of the visceral cavity of this valve is correspondingly narrow (therefore the muscle scars are also approximated). Yet the valve is round as in Obolus.

In default of more exact criterea, we have adopted here and elsewhere the following characters for distinguishing Obolus from Lingulella,— roundness of outline, short cardinal area and depressed beaks, advanced position of muscle scars in the valves, and strong arch of the vascular trunks in the ventral as well as the dorsal valve. There is, however, a more important distinction, which, in consequence of imperfect preservation of the valves, can seldom be observed, that is, the position of the secondary muscles of the central group in the ventral valve, as compared with the great muscle of that group. In Obolus they are *lateral*, but in Lingulella *anterior* to the great muscle. This shows a radical difference of structure between the two genera. It will be observed that the relation of these muscles is as yet unknown in Palæobolus.

PALÆOBOLUS BRETONENSIS. Pl. II., figs. 2*a* to *i*.

Oblately orbicular. Valves evenly rounded from the centre, except that the borders are flattened at the sides and front. Both dorsal and ventral valves somewhat pointed at the umbo, which is depressed in both valves. *Interior of the ventral.*—This has a broad hinge area and a triangular pedicle groove. The visceral cavity has two pairs of diverging ridges, which mark the advance of the lateral muscles during the growth of the shell. Between the outer and the inner pair originate the vascular trunks, which in going forward throw off branches at an acute angle. *Interior of the dorsal valve.*—This valve has a broad, transversely striated hinge area. The visceral cavity is traversed by two pairs of diverging ridges, more widely divergent than those of the ventral valve; there is also a strong median septum along the middle of the valve. The central group of muscle scars are about a fifth from the front of the valve.

Sculpture.—The whole outer surface, except close to the umbo, is ornamented with sharp concentric ridges which occasionally anastomose; these ridges have fine, faintly marked, radiating striæ on their posterior slopes, and are obscurely crenulated along their crests.

Size.—Length 15 mm., width 17 mm. Dorsal valve somewhat shorter than the ventral.

The Obolus nearest this in age is *O.* (?) *major*, of the Upper Etcheminian in New Brunswick; that species, however, is larger, and does not have the concentric ridges, on the only example of it which is known. None of the European Oboli have the sharp ridges which mark the surface of this species, and they all belong higher in the geological scale. *Obolus* (*Mickwitzia*) *monilifera*, Linrs., has a flattened dorsal valve, and thus differs from this species.

ACROTHELE AVIA, n sp. Pl. III., figs. 1*a* to *h*.

Calcareo-corneous. A rather large species with oblately oval valves, thick, horny, shell substance within, and a thin, calcareous crust without.

Outwardly the ventral valve differs little in shape from the ordinary types of Acrothele of the Protolenus and Paradoxides beds; internally, however, it is characterized by a single in place of the paired pits in front of the foraminal opening, and by strong vascular trunks and branches.

The dorsal valve has radiating ridges on the lateral slopes—a character unique to the species. The interior of this valve has, at the umbo, the usual "nail-like process," as Prof. Hartt called it, viz., the median ridge, on each side of which are impressions of the umbonal and lateral muscles. The group of central muscles are somewhat in front of the middle of the valve. Faint impressions of vascular, and of radiating ridges, are also visible.

Sculpture.—The surface of the valves is marked by fine, irregular, concentric rounded ridges, that frequently anastomose. These ridges are more regular in their course on that part of the shell which is near the margins.

Size.—Length 9 mm., width 10 mm. or more.

ACROTRETA PROAVIA, n. sp. Pl. III. figs. 2*a* to *f*.

Shell substance calcareo-corneous. Ventral valve obliquely conical, with a prolonged beak. Cardinal area narrow ; a tubercle below the foramen, which opens behind the beak. The beak of this valve has a heavy overhang beyond the aperture (nearly half its width). The dorsal valve is orbicular, convex, but somewhat flattened towards the front, the interior has two strong muscular pits near the hinge line, spreading vascular impressions, and a broad low median septum.

Sculpture.—A strong lens reveals a series of concentric striæ on the surface of the shell, of which there are about twenty in the space of a millimetre. A still stronger magnification brings to view a granular ornamentation ; occasional rows of coarser granules are seen to be parallel to the concentric striæ.

Size.—Length of ventral valve 2 mm., width 1½ mm. The dorsal valve is 1½ mm. long.

This species differs from all others in its overhanging apex. From having this form the ventral valves are found lying prostrate on the layers and when their dark shining inner layers are exposed look very like the conical teeth of fossil fishes.

They also are not unlike a long conical Lingulella, and may show us a step by which the genus Acrotreta was differentiated from some such form as Lingulella.

BRADORIA* n. gen.

In the Protolenus Fauna are two species of Ostracods, which for want of other known relationship were referred to the genus Primitia. It would appear, however, that in this genus the sulcus which extends from, or near the hinge, downward, should be subcentral. In these two species it is not so, and the depression such as it is, is at or near the anterior end of the hinge line—moreover one of these species (and probably both) is marked by a prominent tubercle, which, from the smoothness of its summit, is supposed to be an organ of vision. It would appear now that these species are representatives of an ancient group of Ostracods which has several specimens in the underlying Etcheminian beds. Though having the general form of Primitia, Primitiella and Aparchites, they do not have the median pit or sulcus of the first, the shallow median depression of the second, or the perfectly smooth valve of the third. Their most marked character is the prominence or tubercle just at the front end of the hinge line. Some of the species have close behind this tubercle a short vertical furrow, scarcely extending clear of the tubercle; or the furrow may pass around the tubercle. In the five species referred here, the marginal furrow is obscure, or invisible along the lower margin.

The known species are nearly of the same size (about 2½ to 4 mm. long) and the surface of the valves is distinctly pitted, tuberculated, or wrinkled.

The following new species come under this genus *B. scrutator*, *B. vigilans*, *B. rugulosus*. It includes also *Primitia oculata* and probably *P. aurora* of the Protolenus Fauna.

BRADORIA SCRUTATOR, n. sp. Pl. IV., figs. 1*a* to *c*.

Valves ovate, with straightened hinge-line, which is more than half of the length of the valve. Furrow short, immediately behind the ocular tubercle. Hinge bordered by a narrow, sharp ridge. Ocular tubercle nearly marginal, and just in front of the hinge. Marginal furrow obscure, extending around the lower margin of the valve.

---

* Named from the Bras d'Or, a salt-water lake occupying the interior of Cape Breton.

Sculpture.—The whole surface is covered with closely set conspicuous pits that are finer toward the hinge-line, where they have a linear arrangement.

Size.—Length 3 mm., width 2 mm.

This species is a little larger than *B. oculata* of the Protolenus Zone, from which it is easily distinguished by the surface ornamentation; the sculpturing is more like that of *Isochilina ventricosa* of the same zone, but that species is much larger.

BRADORIA VIGILANS, n. sp. Pl. IV., figs. 2*a* to *c*.

Outline of the valves ovate with a straightened hinge line, which is about half of the length of the valve. Ocular tubercle at the front of the hinge line, and surrounded by a shallow groove. The margin is gradually rounded at the front, and below, and project somewhat behind, hence it is nearly straight to the hinge.

Sculpture.—Surface marked by closely set granulations, that become finer toward the hinge line and ocular tubercle, and graduate into a series of sub-parallel anastomosing ridges at the posterior quarter of the valve.

Size.—Length 3½ mm., width 2¼ mm.

Distinguished from *Aparchites conchiformis* of the Protolenus Zone by its smaller size and prominent tubercle; and from *A. secunda* by the tubercle and the coarser ornamentation, etc.

BRADORIA RUGULOSA, n. sp. Pl. III., figs. 3*a* to *d*.

A sub-orbicular species, with outline straightened along the hinge line. Ocular tubercle somewhat prominent and situated a little below the anterior end of the cardinal line, which is about half of the length of the shell. There is a faint furrow behind the tubercle nearly parallel to the hinge line, and a shallow pit just in front of the tubercle. A narrow, obscure marginal rim appears at the posterior margin of the valve.

Sculpture.—The lower slopes and posterior half of the valve are covered with fine anastomosing ridges, concentric to the upper side of the valve; toward the top and front of the valve these ridges become obscure and the surface of the valve is granulated.

Size.—Length 2½ mm., width nearly as great.

This little species is easily distinguished from the others by its circular outline and rugulose surface, which simulates that of certain trilobites.

SCHMIDTELLA (?) PERVETUS, n. sp. Pl. IV. figs. 3*a* to *c*.

Only the right (?) valve known. It is moderately arched and without furrows, and its greatest fulness is in the upper half. The hinge margin, which is more than half of the length of the valve is formed by an infolding of the edge, without a furrow. No marginal fold was observed.

Sculpture.—The surface is covered with minute pits closely placed the raised spaces between the pits become so prominent on the lower part of the valve that the surface seems tuberculated; towards the lower and the posterior (?) edges, these tubercles are arranged in rows so that there the valve seems covered with obscure ridges, parallel to the margin; at the opposite side of the valve, toward the hinge, the pits become very fine, and the surface of the valve has a shining appearance.

Size.—Length, 3 mm. Width, 2½ mm.

This species differs from *S. cambrica* of the Protolenus Zone in the less protuberent centre of the valve, and the narrower and straighter infolded border of the hinge line. The marginal fold also is more distinct in *S. cambrica* which does not have the concentric marginal ridges of this species.

SCHMIDTELLA, ACUTA, n. sp. Pl IV., figs. 4 *a. c.*

Valve tumid. Hinge line somewhat more than half of the length of the valve marked by a narrow fold and furrow that extends most of its length. Valve about as wide as long, somewhat acutely pointed at the lower margin. A narrow marginal fold extends along one side of the valve to the pointed end. Greatest protuberance of the valve in the upper half, and towards the hinge the arching of the valve turns suddenly in towards the cardinal line.

Sculpture.—The surface is smooth, somewhat shining, and covered with minute pits or granulations, uniformely distributed.

Size.—Length, 2¼ mm. Width, 2 mm.

This species, by its smooth surface and pointed form recalls the genus Beyrichona of the Protolenus Fauna, but it has not the flattened area near the hinge that marks that genus, and is more flattened in lower part of the valve.

From *S. pervetus* this species is distinguished by its finer ornamentation and pointed lower margin; and from *S. cambrica* by its

smoother surface and narrow fold at the cardinal line. No Silurian Schmidtella has the pointed valve of this species.

DESCRIPTION OF THE PLATES.

PLATE I.

FIG 1. *Lingulella Gregwa*, n. sp. —*a* Ventral valve; *b* interior of same; —*c* Section of same; —*d* Dorsal valve; —*e* mould of interior of same; *f* Section of same. All mag. $\frac{3}{1}$. See p. 199.

FIG. 2. *Lingulella tumida*, n. sp. *a* Ventral valve; *b* mould of interior of same; —*c* Longitudinal section of same. All mag. $\frac{4}{1}$. See p. 200.

FIG. 3. *Leptobolus (?) collicia*, n. sp. *a* Ventral valve; *b* Dorsal valve; —*c* Interior of a broken ventral valve. All mag. $\frac{4}{1}$; —*d* Another ventral, showing the callus of the visceral cavity, mag. $\frac{3}{1}$; —*e* Section of the two valves, mag. $\frac{4}{1}$. See page 200.

PLATE II.

FIG. 1. *Leptobolus atavus*, n. sp. —*a* Ventral valve; —*b* Mould of the interior; —*c* Longitudinal section of same; —*d* Dorsal valve; —*e* Mould of the interior. All mag. $\frac{6}{1}$. —*f* Portion of the outer surface of the shell. Mag. $\frac{40}{1}$. See p. 200.

FIG. 2. *Obolus (Palæobolus) Bretonensis*, n. subgen. et sp.; —*a* Ventral valve; —*b* Interior of same; —*c* Longitudinal section; —*d* Dorsal valve; *e* Interior of same; —*f* Longitudinal section. All mag. $\frac{2}{1}$; —*g* Portion of outer surface of the shell, mag. $\frac{5}{1}$; —*h* smaller portion, mag $\frac{10}{1}$; —*i* Section of the two valves, mag $\frac{2}{1}$. See p. 202.

PLATE III.

FIG. 1. *Acrothele avia*, n. sp. *a* Portion of a ventral valve; *b* Longitudinal section of same. Both mag. $\frac{6}{1}$; —*c* Interior of a ventral valve; —*d* Dorsal valve; —*e* Longitudinal section of same; —*f* Interior of a dorsal valve. The four mag. $\frac{3}{1}$ —*g* Enlargement of the outer surface of the

middle of a dorsal valve; —*h* Enlargement of the surface of the lateral slope of the valve. The two mag. $\frac{10}{1}$. See p. 202.

FIG. 2. *Acrotreta proavia*, n. sp. *a* Ventral valve, upper side; —*b* same, lower side; —*c* same, side view; —*d* Dorsal valve; —*e* Mould of a dorsal valve; —*f* Side view of a dorsal valve. All mag. $\frac{10}{1}$. See p. 203.

FIG. 3. *Bradoria rugulosa*, n. gen. et. sp. *a* Side view of right valve; —*b* Outline from the front; —*c* Outline from the cardinal side; all mag. $\frac{4}{1}$; —*d* Outer surface of the valve; mag. $\frac{10}{1}$. See p. 205.

PLATE IV.

FIG. 1. *Bradoria scrutator*, n. sp. *a* Side view of the left valve; —*b* Vertical section; —*c* Transverse section. All mag. $\frac{4}{1}$. See p. 204.

FIG. 2. *Bradoria vigilans*, n. sp. *a* Side view of the right valve; —*b* Outline, front view; —*c* Outline, cardinal view. All mag. $\frac{4}{1}$. See p. 205.

FIG. 3. *Schmidtella pervetus*, n. sp. *a* Side view of (the right?) valve; —*b* vertical section; —*c* transverse section. All mag. $\frac{4}{1}$. See p. 206.

FIG. 4. *Schmidtella acuta*, n. sp. *a* Side view of (right?) valve; —*b* Vertical section; —*c* Transverse section. All mag. $\frac{8}{1}$. See p. 206.

ERRATA TO THE PRECEDING ARTICLE.

Page.	Line.	
193	21	For "STILETTO, read STILLETTO.
194	5	For "lip," read projecting lip.
195	15	For "trilobites," read Trilobites.
195	16	For "Capulidæ," read Patellidæ.
195	21	For "Lamellibanchs," read Lamellibranchs.

PLATE I.

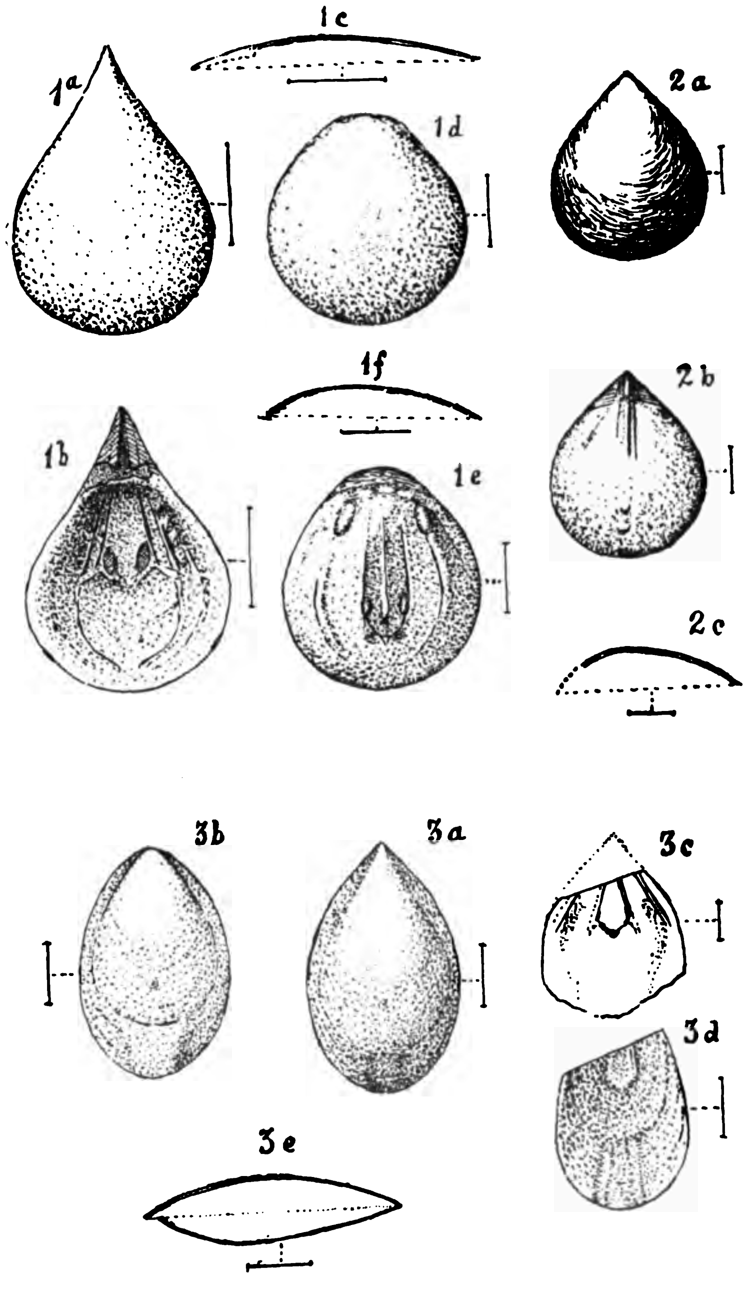


PLATE II.

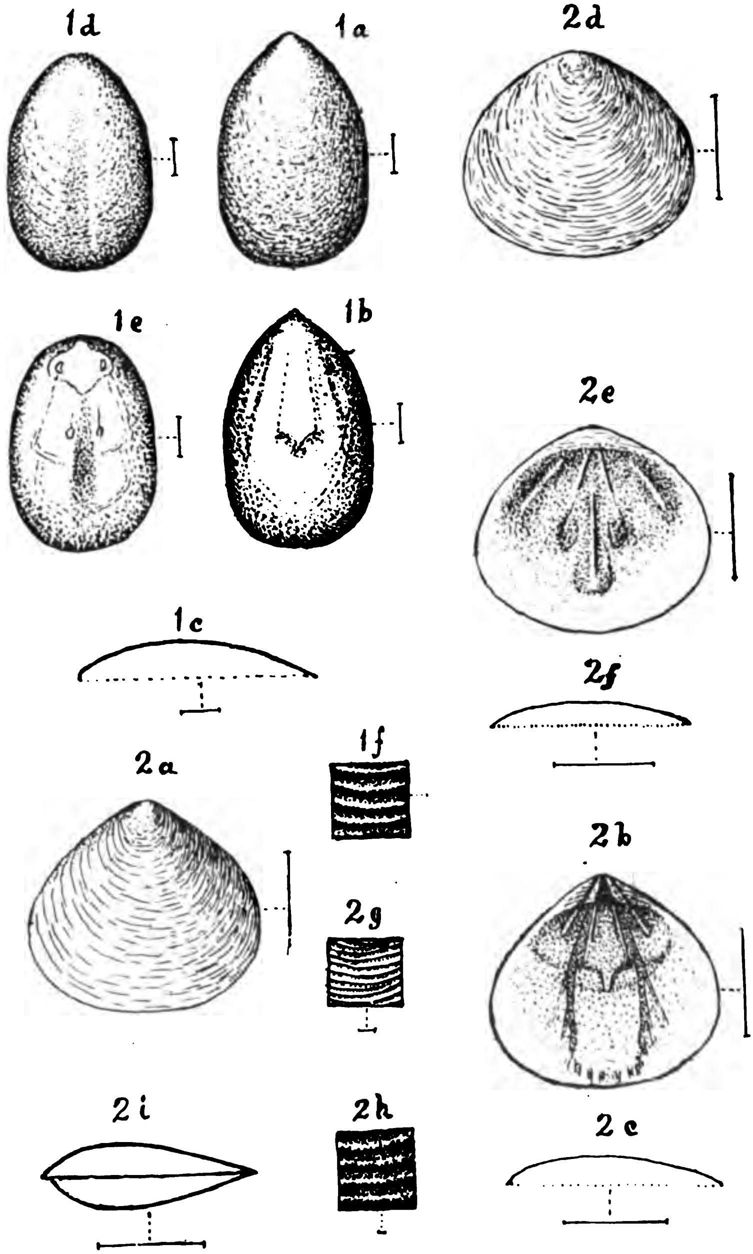
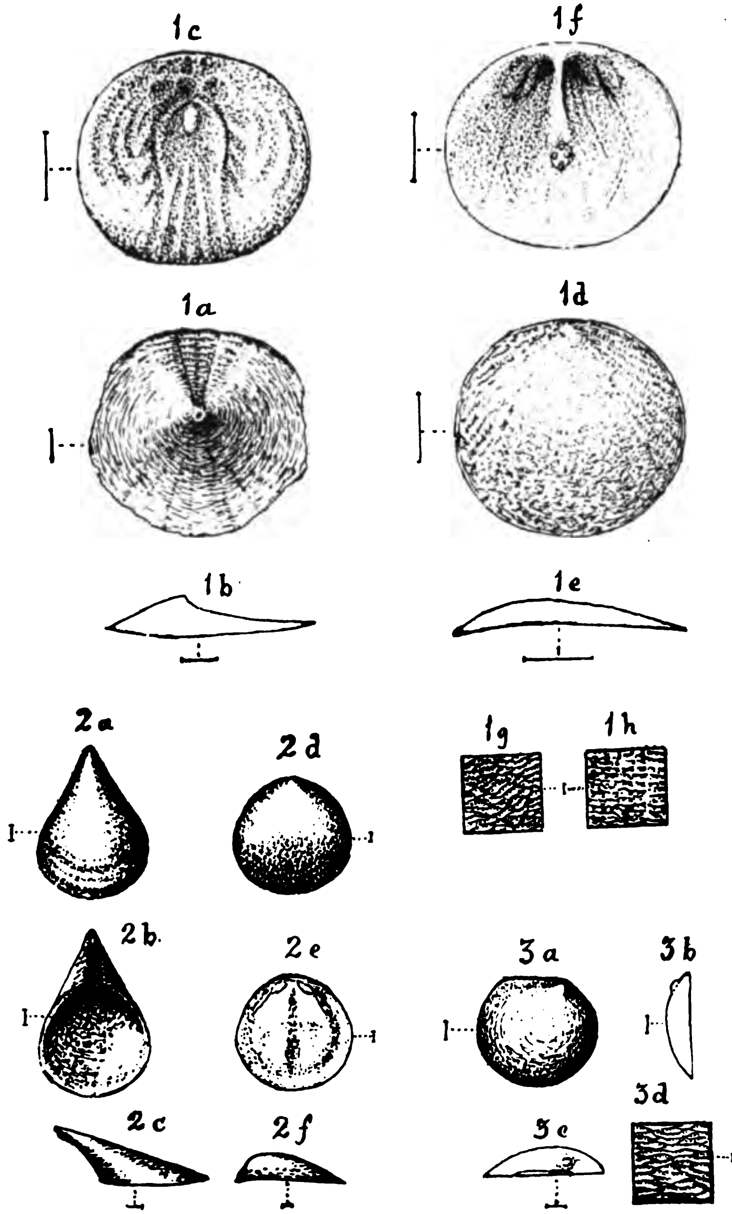
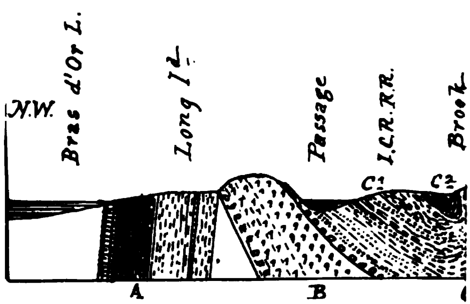


PLATE III.

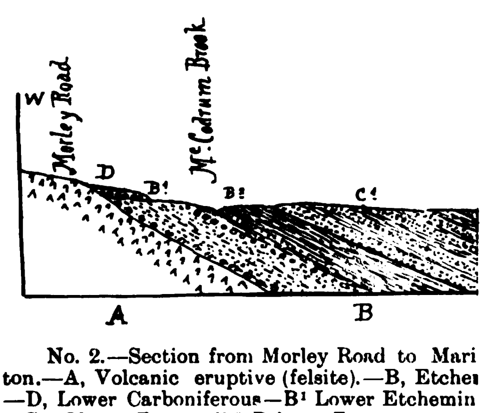


SECTIONS OF THE CAMBRIAN .
IN CAPE BRE]

Showing their relation to each other
palæozic rocks.



No. 1.—Section at Long Island, Bras d'Or I
rentian limestone, schist, etc.—B, Volcanic eru
brian.—D, Prepalæozoic Syenite.—C[1] Olenus Zoı



No. 2.—Section from Morley Road to Mari
ton.—A, Volcanic eruptive (felsite).—B, Etcher
—D, Lower Carboniferous—B[1] Lower Etchemin
—C,[1] Olenus Zone.—C,[2] Peltura Zone.

ARTICLE III.

THE NOCTUIDÆ OF NEW BRUNSWICK.

INTRODUCTORY LIST.

BY WILLIAM MCINTOSH.

Read November 7th, 1899.

The following list of New Brunswick Moths, with the exception of the Jacquet River and Chatham records, is the result of the past three years collecting in the vicinity of St. John.

In the preparation of this list I am much indebted to Dr. James Fletcher, Ottawa, Dr. R. Ottolengue, New York, Mr. Albert F. Winn, Montreal, and Dr. Herman Strecker, Reading, Pa., who have determined my specimens and given me valuable assistance in my entomological work.

I am under obligation to Mr. Winn, not only for identifying a number of specimens, but also for a very interesting list (in MS.) of Moths taken at Jacquet River in July and August, 1886. All the Jacquet River records are taken from Mr. Winn's list.

The Chatham records are from Mr. J. D. B. F. Mackenzie's List of the Moths of Miramichi (Proceedings of the Natural History Society of Miramichi).

Thanks are due also to Mr. Philip J. R. McIntosh, who kindly placed his collection in my hands for examination.

FAMILY THYATIRIDÆ.

Thyatira scripta, Gosse.

Common at light during June and July.

Pseudothyatira cymatophoroides, Gn.

Two specimens taken at light July 10th and 22nd (1897). Also at Jacquet River.

Pseudothyatira cymatophoroides var expultrix, Grt.

A few specimens taken every year from July 16th to August 2nd. Also at Jacquet River.

Leptina doubledayi, Gn.

One specimen taken June 13th (1898).

FAMILY NOCTUIDÆ.

Demas flavicornis, Smith.

Three specimens, June 26th and 28th.

Raphia frater, Grt.

Two specimens, July 20th and 28th (1898).

Acronycta morula, G. & R.

Chatham.

Acronycta innotata, Gn.

Quite numerous during June and July. Also taken at Jacquet River.

Acronycta populi, Riley.

One or two specimens taken at light.

Acronycta vulpina, Grt.

One taken at light.

Acronycta americana, Harr.

Several specimens taken at light in July. Also reported from Jacquet River and Chatham.

Acronycta dactylina, Grt.

A few specimens taken each year ; but not at any time abundant.

Acronycta impressa, Wlk.

Two specimens taken during the present year.

Acronycta superans, Gn.

Jacquet River.

Acronycta dissecta, G. & R.

Jacquet River.

Harrisimemna trisignata, Wlk.

One perfect specimen at light August 2nd (1899).

Micrococlia fragilis, Gn.

Two taken July 20th (1899).

Chytonix palliatricula, Gn.

One specimen captured at light July 18th (1899).

Rhynchagrotis chardinyi, Bdv.

Several taken during the present year. Also at Jacquet River.

Rhynchagrotis minimalis, Grt.

One specimen (1898).

Rynchagrotis placida, Grt.

One at light in July.

Rhynchagrotis alternata, Grt.

This species is usually abundant on Willow blossom in April and May.

Adelphagrotis prasina, Fabr.

Very common at light during July. Also taken at Jacquet River.

Platagrotis pressa, Grt.

Taken in limited numbers in July. Also at Jacquet River.

Eueretagrotis perattenta, Grt.

One specimen taken at light in July.

Pachnobia salicarum, Wlk.

This species is quite numerous on Willow blossom in April and May.

Agrotis ypsilon, Rott.

This Moth is exceedingly common, dozens being taken at light in a single evening. Also taken at Jacquet River.

Peridroma occulta, Linn.

This species, is quite numerous at light on old walls, fences, etc. Reported from Jacquet River.

Peridroma astricta, Morr.

One or two specimens taken in July.

Peridroma saucia, Hbn.

A few specimens taken during the past season—August.

Noctua baja, Fabr.

Abundant at light in August. This species varies considerably; some specimens are ashy gray, while others are pale reddish brown. Also taken at Jacquet River.

Noctua normaniana, Grt.

Several at light July and August.

Noctua c-nigrum, Linn.

This is one of the most common Moths in this locality—July to October. Also reported from Jacquet River.

Noctua jucunda, Wlk.

One at light in July.

Dr. Strecker, referring to the specimen sent for identification, says: "A very decidedly marked example; I never saw one so richly colored or distinctly marked; but I do not doubt it is this species."

Noctua phyllophora, Grt.

Three specimens taken during the present year.

Noctua rubifera, Grt.

One taken late in July.

Noctua fennica, Tausch.

Twelve or fourteen specimens taken during the past three years.

Noctua plecta, Linn.

A limited number taken in June, July, and early in August. Also at Jacquet River.

Noctua collaris, G. & R.

Two specimens taken at light—July.

Noctua haruspica, Grt.

Abundant at light in July. Also taken at Chatham.

Noctua clandestina, Harr

Jacquet River.

Feltia subgothica, Haw.

Not uncommon at light during August. Also taken at Jacquet River and Chatham.

Feltia herilis, Grt.

A few specimens yearly ; not so abundant as the preceding species.

Feltia venerabilis, Wlk.

Several at light during the present year. Also at Jacquet River and Chatham.

Porosagrotis mimallonis, Grt.

One taken August 13th.

Carneades quadridentata, G. & R.

Two specimens taken, August 26th (1899.)

Mr. Strecker informs me that heretofore he has only seen this from the West.

Carneades fumalis, Grt.

One at light.

Carneades pitychrous, Grt.

Chatham.

Carneades messoria, Harr.

Jacquet River.

Carneades lutulenta, Smith.

Very numerous at light for about a week in August (1898–99).

Carneades mollis, Wlk.

A few specimens of this beautiful Moth taken at Willow blossom in May. Also a number of what appears to be a darker form taken at light.

Carneades decolor, Morr.

One at light.

Carneades tessellata, Harr.

Quite numerous at light early in July.

Carneades ochrogaster, Gn.

Very abundant at light in August. Three forms of this variable insect is common here.

Carneades redimicula, Morr.

A few specimens taken at light during the first week in August.

Mamestra nimbosa, Gn.

This beautiful Moth is taken in limited numbers at light in August. Also at Chatham.

Mamestra imbrifera, Gn.

Two at light.

Mamestra purpurissata, Grt.

Several taken at light in August.

Mamestra detracta, Wlk.

Two taken July 20th (1899).

Mamestra radix, Wlk.

Two taken at light near Gagetown.

Mamestra canadensis, Smith.

In Prof. J. H. Smith's Catalogue of Noctuidæ, New Brunswick is the only locality given for this Moth. We have no local record of its capture.

Mamestra subjuncta, G. & R.

Four specimens taken July 12th, 15th and 27th.

Mamestra grandis, Bdv.

One taken early in October (1899).

Mamestra trifolii, Rott.

One taken at light July 10th (1897).

Mamestra picta, Harr.

A few taken at light during the present year—July.

Mamestra lubens, Grt.

Three taken in 1897 ; and one at light July 18th of the present year.

Mamestra assimilis, Morr.

One taken by Philip McIntosh July 18th (1899).

Mamestra latex, Gn.

Chatham.

Mamestra adjuncta, Bdv.

A few specimens at light in June and July.

Mamestra legitima, Grt.

Two specimens taken at light early in July.

Mamestra lilacina, Harv.

One taken by Philip McIntosh July 2nd (1899).

Mamestra renigera, Steph.

A few specimens taken every year. Also reported from Jacquet River and Chatham.

Mamestra olivacea, Morr.

During July and August this species is very common at light. Also taken at Chatham.

Mamestra lorea, Gn.

Jacquet River.

Hadena passer, Gn.

A few taken at light during the latter part of July.

Hadena remissa, Hbn.

Two or three specimens taken each year from the 8th to 20th of July.

Hadena vultuosa, Grt.

Two taken July 22nd (1898) and August 1st (1899).

Hadena finitima, Gn.

One at light July 1st (1899).

Hadena dubitans, Wlk.—(Sputatrix, Grt.)

Common at light under logs and in crevices during August. A very light form of this species is abundant here.

Hadena impulsa, Gn.

Two taken July 6th and 11th (1898-99).

Hadena devastatrix, Brace.

This species is quite common during July, August, and the first part of September. Also reported from Jacquet River and Chatham.

Hadena arctica, Bdv.

This beautiful insect is so common in July and August that it is a nuisance at light; also taken at bloom resting on fences, etc. Reported from Jacquet River.

Hadena verbascoides, Gn.

A few taken at light in July.

Hadena bridghami, G. & R.

Taken in limited numbers late in July and early in September.

Hadena minuscula, Morr.

One specimen taken August 14th (1899).

Hadena modica, Gn.

A few taken at light early in August.

Hyppa xylinoides, Gn.

Not uncommon at light in July. Also at Chatham.

Trigonophora periculosa, Gn.

Three specimens taken in August (1898–99). Also at Jacquet River.

Trigonophora periculosa (var. v-brunneum), Grt.

Jacquet River.

Brotolomia iris, Gn.

Very abundant during the last of June and early in July.

Euplexia lucipara, Linn.

Two specimens at light July 15th and 26th (1899).

Nephelodes minians, Gn.

Common at light, in crevices, etc.—July and August.

Tricholita signata, Wlk.

Three or four specimens taken in August.

Helotropha reniformis, Grt.

One taken on bloom August 17th (1898).

Hydrœcia velata, Wlk.

Extremely common from July 25th to September 20th.

Hydrœcia nictitans, Linn.

Very abundant at light; flying during the same season as Velata. Also at Jacquet River.

Hydrœcia nictitans (var. erythrostigma), Haw.

Taken at light during the entire month of August, but not so abundant as the preceding species.

Hydrœcia medialis, Smith.

One taken September 2nd (1898).

Hydroecia cerussata, Grt.

Several taken every year, but not at any time abundant.

Leucania pallens, Linn.

A few specimens taken yearly in July. Also at Jacquet River.

Leucania extincta, Gn.

Several taken in the middle of July (1899).

Leucania insueta, Gn.

Two taken in July (1899). Also at Jacquet River.

Leucania commoides, Gn.

Several at light during July and August. Also at Chatham.

Leucania unipuncta, Haw.

This species is taken every year, but does not appear to be very numerous.

Leucania pseudargyria, Gn.

Jacquet River.

Caradrina multifera, Wlk.

Jacquet River.

Amphipyra tragopoginis, Linn.

Abundant at light from the 12th to 30th of August.

Orthodes puerilis, Grt.

Two specimens taken in July (1899).

Crocigrapha normani, Grt.

One taken May 20th (1899).

Tæniocampa furfurata, Grt.

Several specimens taken in July (1899).

Tæniocampa alia, Gn.

Not uncommon at Willow blossom in May.

Cosmia paleacea, Esp.

Several taken at light early in September.

Pyrrhia umbra, Hbn.

Very abundant for about a week during the latter part of June.

Orthosia conradi, Grt. (?)

Jacquet River.

Xanthia flavago, Fabr.

Two specimens taken in 1897.

Cirrœdia pampina, Gn.

Chatham.

Scoliopteryx libatrix, Linn.

One taken by Philip McIntosh. Also reported from Chatham.

Scopelosoma devia, Grt.

One taken by Philip McIntosh May 15th, 1898.

Xylina disposita, Morr.

Several taken in May (1898).

Xylina ferrealis, Grt.

Two specimens taken in May (1898).

Xylina bethunei, G. & R.

One taken by Phiiip McIntosh May 1st (1899).

Xylina laticinera, Grt.

Three specimens taken in May 1898.

Xylina thaxteri, Grt.

One May 10th (1898).

Colocampa nupera, Lint.

Three or four specimens taken during the past three years.

Cucullia convexipennis, G. & R.

Taken in limited numbers in August.

Cucullia asteroides, Gn.

A few taken in June.

Cucullia intermedia, Speyer.

Common at light June and July. Also reported from Jacquet River and Chatham.

Aletia argillacea, Hbn.

Abundant at light in September and the earlier part of October. On the 11th of October, 1897, this species appeared in immense numbers.

Abrostola urentis, Gn.

A few taken in July. Apparently rare.

Deva purpurigera. Wlk.

Two specimens taken by Philip McIntosh.

Plusia ærea, Hbn.

Three taken in July 1898.

Plusia aeroides, Grt.

Much more abundant than the preceding species. Also taken at Jacquet River.

Plusia balluca, Geyer.

Only two or three specimens taken each year.

Plusia contexta, Grt.

Jacquet River.

Plusia putnami, Grt.

Not common; taken at light in July and August.

Plusia mappa, G. & R.

Taken in limited numbers in July.

Plusia bimaculata, Steph.

A very common species; taken in July August and September. Also at Jacquet River and Chatham.

Plusia precationis, Gn.

Abundant from June to October. During the present year this species was common on blossom until November 5th.

Plusia flagellum, Wlk.

(Syn. monodon-insolita.)

A few specimens taken each year in June and July.

Plusia brassicæ, Riley.

Only one or two taken at bloom in August.

Plusia mortuorum, Gn.

Very common at light and bloom in July and August. (Dr. Ottolengui states that this species is "erroneously called u-aureum in American collections.") Also taken at Jacquet River.

Plusia retangulum, Kirby.

Dr. Ottolengui informs me that this species, known as mortuorum in American collections, is really Kirby's retangulum. This Moth is exceedingly common at light and on bloom, July, August, and early in September. Also taken at Jacquet River.

Plusia octo-scripta, Grt.

Common at light and bloom, July, August, and early in September.

Plusia falcifera, Kirby.

Seven or eight specimens taken from July 30th to September 7th.

Plusia selecta, Wlk.

(Syn. viridisignata, Grt.)

Four taken in August.

Plusia epigæa, Grt.

Not uncommon at light and bloom in July and August.

Plusia ampla, Wlk.

Only three or four specimens taken during the past three years—August 4th to 11th.

Plusia simplex, Gn.

A few taken at light and bloom. Also at Jacquet River and Chatham.

Calpe Canadensis, Bethune.

One specimen taken on bloom July 15th (1899).

Heliothis armiger, Hbn.

One taken September 15th (1899).

Alaria florida, Gn.

Two taken in August (1897).

Metathorasa monetifera, Gn.

Two specimens taken in July (1897-98).

Erastria apicosa, Haw.

Jacquet River.

Drasteria erechtea, Cram.

Abundant from June to October. Also at Jacquet River.

Drasteria erichto, Gn.

Several taken with erechtea in June.

Euparthenos nubilis, Hbn.

Known to occur in this locality, but not taken by the writer.

Catocala cerogama, Gn.

One taken in August (1899).

Catocala ultronia, Hbn.

Several taken every year--August and September. Also at Chatham.

Catocala ilia, Cram.

Two specimens taken September 12th and 16th (1898).

Catocala parta, Gn.

Several are known to have been taken in this locality some years ago.

Catocala unijuga, Wlk.

A few specimens taken during the latter part of August Also at Jacquet River.

Catocala concumbens.

Not uncommon ; taken at light and sugar in August and September.

Catocala relicta, Wlk.

This beautiful insect is not uncommon in this locality. August and September.

Catocala antinympha, Hbn.

Chatham.

Catocala cœlebs, Grt.

One specimen taken by Philip McIntosh.

Parallelia bistriaris, Hbn.

One taken July 16th (1898).

Homoptera lunata (var. edusa), Drury.

One specimen taken resting on a wall June 4th (1897).

Ypsia undularis (var. aeruginosa), Gn.

A pair taken resting on trees.

Epizenxis æmula, Hbn.

A few specimens taken late in August (1899).

Hypena scabra, Fabr.

Chatham.

FAMILY BREPHIDÆ.

Brephos infans, Mœschl.

In April this interesting Moth was quite numerous in groves of small birch trees near the city; but only two specimens were taken.

ARTICLE IV.

THE BUTTERFLIES OF NEW BRUNSWICK.

BY WILLIAM McINTOSH.

(Read November 7th, 1899).

In Bulletin No. XVII, pages 114–121, I gave a list of the butterflies of this province as far as known to me. During the past season a number of additional species have been captured near St. John; these will be found in the following supplementary list. Mr. Albert F. Winn, of Montreal, also sent me some very interesting notes on butterflies taken at Jacquet River, New Brunswick, in 1886. Among Mr. Winn's captures are two species not recorded in my former list; these are also noted below:

Phyciodes nycteis, Double-Hew.

(Charidryas nycteis).

One specimen taken at Welsford, July 1st.

Thecla titus, Fabr.

(Mopsus, Hubn. Strymon titus).

Two specimens captured in the Nerepis valley in July.

Feniseca tarquinius, Fabr.

Three specimens of this curious little butterfly were taken during the past summer, July 16th and 31st.

Lycæna couperii, Grote.

Taken at Jacquet River by Mr. Winn. "Was quite common during early July ; one stray specimen August 8th."

Pamphila manitoba, Scud.

(Erynnis manitoba).

"A few taken towards the end of August" by Mr. Winn at Jacquet River.

Pamphila metacomet, Harris.

(Euphyes metacomet).

Not uncommon at Welsford and Westfield in July and early in August.

Eudamus pylades, Scud.

(Thorybes pylades).

This species was quite abundant at Welsford, Nerepis and Quispamsis during the past summer.

NOTES.

Melitæa phaëton.— On July 1st I had the pleasure of taking a number of perfect specimens of this beautiful butterfly.

Melitæa harrisii.— Over forty of this species were taken in about two hours on July 1st. Worn specimens were plentiful in the same locality July 15th. On August 1st (my next visit) they had entirely disappeared.

Mr. Winn, speaking of this species, says: "One specimen, taken end of July, flying before 5 A. M.

Grapta gracilis. — Mr. Winn refers to this species as follows: "I can confirm occurrence in New Brunswick, having taken a few specimens during the latter part of August.

Two specimens were taken by the writer July 15th (1899).

Pieris napi.—Mr. Philip McIntosh found this species quite abundant on the Belleisle in July. The following is quoted from Mr. Winn's notes: "Pieris oleracea (napi.) Was then (1886) abundant at Jacquet River, but doubtless has decreased proportionately as Pieris rapæ increased, as it has done elsewhere."

Colias interior.— This species still continues to be our most common yellow. Colias philodice not being abundant until late in the season.

ARTICLE V.

NOTES ON THE NATURAL HISTORY AND PHYSIOGRAPHY OF NEW BRUNSWICK.

By W. F. Ganong, Ph.D.

23.—The Forestry Problem in New Brunswick.

(Read March 7th; revised December, 1899.)

The greatest natural source of wealth of New Brunswick lies in her forests. These are steadily deteriorating. The public is uninformed and hence indifferent as to their fate. These three facts constitute a forestry problem of the gravest character, and one vastly important to the future of this province.

Probably there is no other part of the earth's surface that originally bore a nobler forest on a land so richly watered. Some of the most valued timber trees of the northern temperate zone grew in New Brunswick, and completely clothed her hills and valleys from her farthest inland waters all around to the sea. Every part of the province is penetrated by streams which, while swift, are never torrents; and these by the melting of the abundant snows of winter are made passable for the lumber which thus may be carried cheaply into the many large rivers, and down these to fine harbors at their mouths. Immense tracts in the province are admirably adapted for tree growing, and are useless for any other known purpose. Thus has Nature provided in New Brunswick the conditions for a great industry, and thus does she point out our most profitable occupation for the future, when lumbering must be based upon forestry, which consists not in the hunting of trees but in their cultivation.

In the meantime, however, New Brunswick forests are being irretrievably damaged. I do not now refer to defects in forest regulations, systems of cutting, stumpage, etc., for I know nothing about this subject. I have inferred, however, from the numerous newspaper writings of the late Edward Jack, who knew these matters so practi-

cally and thoroughly, that our general system of forest management is far from provident. But there is one deadly enemy of our forests whose worst visitations can never be entirely recovered from, and that is the great forest fires. It is not only the timber they destroy that makes these fires so bad, for in a generation or two it may be partially restored, but it is the permanent injury they do to much of our soil whereby its capacity to produce trees for the future is permanently lessened or even practically destroyed. Where naturally the soil is thin, as it is over the rocky hills underlying much of our forest land, the roots and other organic matter binding it together is utterly burnt out by the great fires, and the rain washes the earth off into the streams, leaving behind but the naked rocks, hostile to vegetation. Most of that soil was placed there originally by the ice of the glacial period, and has ever since been held in position by its continuous covering of vegetation; once removed it can be restored only with the most extreme slowness. An awful example of this practically permanent destruction is to be found in an area many miles square on the upper Lepreau river; the still standing rampikes and great stumps show how fine a forest once clothed this land, which now is but a stony desert that not for generations, and perhaps never, can again bear trees. Here is a tract of country that might to-day be yielding a revenue to the province and supporting a considerable village at the mouth of the river, but it lies waste and useless because a fire twenty years ago was not stopped in time. This is an extreme case, but large areas in the province have suffered in but little less degree. The prevention of forest fires is the first problem of forestry in any country, and it has to be solved not only by stringent laws upon railroads, lumbermen, hunters and settlers, but also by a ranger service, a corps of men whose business it is to watch for fires in the dangerous season, and to extinguish them at their beginning. The ranger service may well be combined with that of fish and game wardens, and even with some phases of lumber surveying.

But in addition to loss of timber and permanent injury to the soil, there are yet other losses suffered through the deforesting of a country.* Aside from the still unsettled question as to the effect of forests upon

* The reader who wishes further information upon these subjects will do well to turn to the publications of the Division of Forestry of the U. S. Department of Agriculture, including their recent "Primer of Forestry" and articles in the Year Books of the Department, and also to the reports of the Maine Forestry Board.

the amount and regularity of annual rainfall (both of which, as many students think, are increased by the presence of forests, to the great advantage of the farmer) it is everywhere known that the removal of forests leads to great fluctuations in the water level of rivers, periods of extreme low water alternating with destructive floods. This not only interferes with navigation upon the smaller rivers, but greatly lessens the value of their waterpowers, a subject certain to become of great practical importance in the near future, since, as the leading authorities agree, the improvements in the conduction of power by electricity are sure to make natural sources of power again of value. Destruction of forests, too, destroys their game-producing power, and the fish-producing power of their streams, and hence removes their attraction to wealthy sportsmen whom New Brunswick is doing her best to attract. Yet other losses, sentimental as well as economical, which a people may suffer with loss of their forests, will occur to all.

Deforesting may, of course, occur in other ways, and lead to the same losses, though these are far less in degree than fires entail. Land cleared for cultivation, though partially kept intact by the farmer's crops, suffers slow deterioration, but this loss is unavoidable and slight in proportion to the gain. Especially reckless lumbering sometimes lays an area well nigh waste, allowing of similar deterioration, particularly since such places are very liable to fires. At the present day the forests are threatened by a new danger—the rapacity of pulp-mills, which take lumber even as small as five inches diameter, and hence practically clear the land where they operate, leaving little to grow into timber for the future. No pulp-mill should be allowed to operate in New Brunswick in a way to deforest any piece of land, for a speedy profit of this kind will be dearly paid for in the future. The only wise method in forestry management is to keep a forest intact, and this can be done only by a system of rotation in cutting, by which the larger trees alone are removed, the smaller being left to grow. The prevention of forest fires, and a wise system of cutting, would make the annual lumber crop as certain and as continuous as the agricultural crop. This would give permanence to settlements in the lumber districts and increase the prosperity and contentment of our people. What would it not mean to Charlotte county to-day if her lumber had not been recklessly cut away and her best lands badly burnt over?

It will be a long time yet before tree-planting will pay in New Brunswick, though some day it will. There is one situation, however, in which I think a certain amount of cultivation would pay in the near future. In St. John and Charlotte counties, and in lesser degree in other parts of the province, are many abandoned farms growing up in trees. Left to themselves these trees are oftener than not of worthless sorts, and grow so densely as greatly to injure one another in the struggle that ensues. If pine and the best spruce were established on these lands, and kept thinned out, they would in time yield ample returns, returns that no individual can afford to wait for, though a government, with its borrowing capacity, can. Care should be taken in future, too, not to grant for settlement land that is better suited for trees than for agriculture.

Under so purely democratic a government as that of New Brunswick, no legislature can afford to take steps not backed by public opinion. Any movement entailing much present expense for a distant return would undoubtedly be condemned by the people. If, however, the great importance of this subject to the future of the province were generally understood, the people could be trusted to respond in its favor as they have for education and other great interests. It is, however, the duty of the government to take the first step, which should be towards the acquisition and dissemination of knowledge upon the subject of forestry in all its aspects and in its relation to allied interests, such as game preservation, fishing licenses, water-powers, location of settlements, etc.; and, following this, should come the formulation of a broad plan for the economic management of these great public interests. The experience of other countries shows that such wide-reaching investigation must be made independent of the exigencies of local politics, which can be done only by placing the whole subject in the hands of a commission, unpaid except for expenses, composed of the most public-spirited and able citizens. Surely New Brunswick is not so poor that she cannot command this service from her sons.

24.— Cost of a Topographical Survey of New Brunswick.

(Read April 4th, 1899).

In a former note upon this subject (No 14), I pointed out that a survey of New Brunswick upon the plan and scale of that of Massachusetts would cost at least $351,000, and probably much more,

perhaps $500,000. Mr. Henry Gannett, Geographer of the United States Geological Survey, and the leading American authority upon this subject, in acknowledging the receipt of a copy of the afore-mentioned note, writes me as follows: "Referring to what you say concerning a survey of the province, let me suggest that a scale of about two miles to an inch is sufficiently large for present requirements. This is the scale which we are using in this country for the greater part of our territory and find it, on the whole, most satisfactory."

"The expense of a survey for this scale, including all the operations incident to the production of the manuscript maps amounts on an average, to about $5.00 to a square mile, which for the area of New Brunswick, will be about $140,000, which is not a prohibitive price to pay."

A very complete, and of course authoritative, account of the methods of conducting topographical surveys and of constructing topographical maps is given by Mr. Gannett, in his "Aims and Methods of Cartography" recently published by the Geological Survey of Maryland (Special Publication, Volume II., Part IIIA, 1898), and this work is invaluable to all interested in this subject.

A topographical survey of New Brunswick must in time be undertaken, and so great will be its scientific and economic benefits that this Society should use its utmost influence to have it begun as soon as possible.

25.—What is the Highest Land in New Brunswick?

(Read April 4th; re-written December, 1899.)

In former notes of this series (Nos. 5 and 19), it was pointed out that two hills compete for the honor of being the highest in New Brunswick, namely: Big Bald Mountain on the South Branch of Nepisiguit, and another unnamed mountain three miles south of Mount Sagamook near Nictor Lake. The latter of these two, I shall, for reasons to be given in a later note (No. 30) call Mount Carleton.*

The height of Big Bald was measured in 1880 by Mr. Ells, and

* I find that I was probably mistaken in my supposition (Note 19) that this mountain was the one to which the name Bald originally and properly belonged. It is Sagamook which is called Bald by the guides and others, and on the early plans. Mount Carleton appears hitherto to have been entirely unnamed.

found to be 2,500 feet, as given in his Geological report. The geological map marks it, however, as 2,700 feet; but as Mr. Ells is the only one who has measured it, the greater height upon the map appeared to be an error. Mr. Chalmers, however, has recently written me as follows: "So as to settle the question of the height of Big Bald Mountain, South Branch Nepisiguit, as far as it is possible to do so with the aneroid, Mr. Ells and I have gone carefully over his notes and barometric readings again. He has two sets of readings, one taken while going up river from Bathurst Harbour, the other taken when returning. Observations were made regularly every day, and at the camping grounds morning and evening several times. Working out the figures both ways we find the results to be very close, *and the mean elevation of Big Bald Mountain to be 2,715 feet above sea level.*" This gives a definite basis for the height of 2,700 feet commonly assigned to that mountain.

Some new facts as to the height of its rival, Mount Carleton, are here to be presented. In August last, I climbed and measured it. I made it by direct measurement with aneroid 112 feet higher than Mount Sagamook, and this I made by a mean of two measurements, 1,633 feet above Nictor Lake. Nictor Lake I made by a mean of fourteen measurements, all corrected from simultaneous readings at Fredericton, (see later Note 31) 837 feet above sea level. This would make Carleton 2,582 feet above the sea level. I have reason to think, however, that this result is considerably too low. I have found that my barometer moves slightly sluggishly, and moreover other good measurements of Nictor Lake and Sagamook Mountain have given considerably higher results. Thus Mr. Chalmers gives the height of Nictor Lake as 878 feet, and Sagamook as 1659 higher. On this basis Carleton would be 2649 feet. There is, however, another set of measurements of lake and mountain which cannot be disregarded, the more especially since they were made with mercurial barometers, which are much more reliable than aneroids. In 1839 a series of such measurements, checked by comparison with a fixed station at Grand Falls, was carried across the province by way of Nictor Lake, by a Mr. Wightman, employed by the British government in connection with the elucidation of the highlands of the boundary disputes, and the results are given in full in the Blue-book, "The North American Boundary," 1840. All of his measurements however, while relatively accurate, are absolutely

too low, and we must apply to them a correction of fully 100 feet.* As the mean of many careful observations he made the surface of Nictor Lake 777 feet above the sea, *i. e.*, with the correction 877 feet. He made Bald Mountain (or Sagamook) 2496 feet, *i. e.*, 2596 with the correction. If to this we add the 112 feet which Carleton surpasses Ságamook or Bald, we have as the height of Carleton 2708 feet, which is very close to the 2715 of Big Bald.

If one were to take Hind's correction of 123 feet for Wightman's results, instead of the 100 here adopted, it would make Carleton 2731 feet, thus surpassing Big Bald considerably. I by no means think, however, that reliance can be placed upon these latter figures, but they at least should make us cautious in forming a judgment as to which is the higher mountain. Big Bald and Carleton must be very near the same height, with the probability in favor of Big Bald. The relative heights could be best settled by a comparison of careful theodolite measurements made from the summit of each upon the summit of the other.

26.—On a Division of New Brunswick into Physiographic Districts.

(Read May 2nd, 1899.)

Whoever attempts a systematic description of any class of facts or phenomena, or treatment of phases of local history, for the whole of New Brunswick, must feel the need for some natural and recognized

* Wightman's figures are too low, because it was assumed that the levels along the St. John, from Fredericton to Grand Falls, made in 1826 by Foulis, were correct, whereas they are inexplicably erroneous and low. Hind (Geological Report, 1865, 31) has shown that this is the case, and arguing from levels taken by Graham in connection with the survey of the north line in 1843, and from those on the Royal Road, he reasons that Foulis' figures are about 123 feet too low. Other measurements by Wightman himself show a discrepancy between head of tide above Fredericton and high tide on Bay Chaleur of 77 feet, which is explained by the report as due to high tide level at Fredericton being 80 feet above high tide level at St. John. This we now know is erroneous, for Duff has shown (this Bulletin, XV, 69) that mean tide at Fredericton is only about 14 feet above mean tide at St John, and hence high tide level is about the same at both places. But I think Hind puts the correction for Wightman's error too high, for I think Graham's figure of 419 feet for the river above the fall is too high. It is higher than the Royal Road levels. Graham, moreover, gives the monument at source of the St. Croix as 538 feet above mean tide at Calais; later measurements of the surface of Grand Lake (from which there is continuous deadwater to the monument) based I believe on railroad levels, given on the geological map, make it only 499 feet. Probably we would be safe in giving a correction of 100 feet to Wightman's figures, though if we wished to be extra conservative we might restrict it to the correction supplied by Wightman himself in his difference of 77 feet above high tide in Bay Chaleur, plus 3 feet to reduce the latter to mean tide, that is, in all 80 feet.

division of the province into districts. In a work now nearing completion I have had to make such a division, and thus have given some study to the subject, with the following results. For a detailed natural division the counties, with their artificial boundaries, are not available; and the geology, with its correlated topography, is too irregular and complicated. We do find, however, a convenient and fairly natural division in the river systems, which for historical purposes is especially suitable, since they have powerfully influenced the distribution of settlements. But if we attempt to separate these systems by lines drawn along their watersheds (as is done on the accompanying map, fig. 1), we see at once that in a general way there is a correspondence between counties and river systems. This is, of course, no mere accidental coincidence, but is the result of a true causal relation, for the principle that has determined the setting off of our counties has been that of grouping them around the river basins and running their boundaries along the watersheds.* It will obviously be convenient in making our natural divisions to pay as much attention as possible to the familiar county divisions, and hence the boundaries of the latter may well be used to settle doubtful points in the natural divisions. There are two cases in which it is profitable to use the county divisions to determine details of the natural divisions —first, in the points of separation of the systems along the sea coast (for here the county lines have been very wisely chosen), and second, in the secondary division of the large St. John system. The geology also, in doubtful cases, may be called to aid. Taking into account all of these factors, the river system districts of New Brunswick would appear to be as follows, and as traced on the accompanying map. Natural divisions should obviously be known by indigenous names, for which, happily, convenient Indian names are available.

I. The Passamaquoddy (or Charlotte) District. Includes the basins of all rivers from the Cobscook to Point Lepreau.

II. The Woolastook (or St. John) District. Includes the entire St. John System and the smaller rivers from Point Lepreau to Martins Head.

* That river systems and counties do not correspond yet more closely is due to three causes:—First, county lines are, for convenience of running and marking, best made straight, while watersheds are crooked; second, the geography of the province was imperfectly known when some of the lines were established by law, and hence they do not run as it was supposed they would; third, some of our rivers run so far across the province and head so near the basins of others, it is practically more convenient to allow their heads to fall into other counties. Such is the case with the St. Croix and Magaguadavic, Washademoak and Salmon River, Miramichi, and Restigouche.

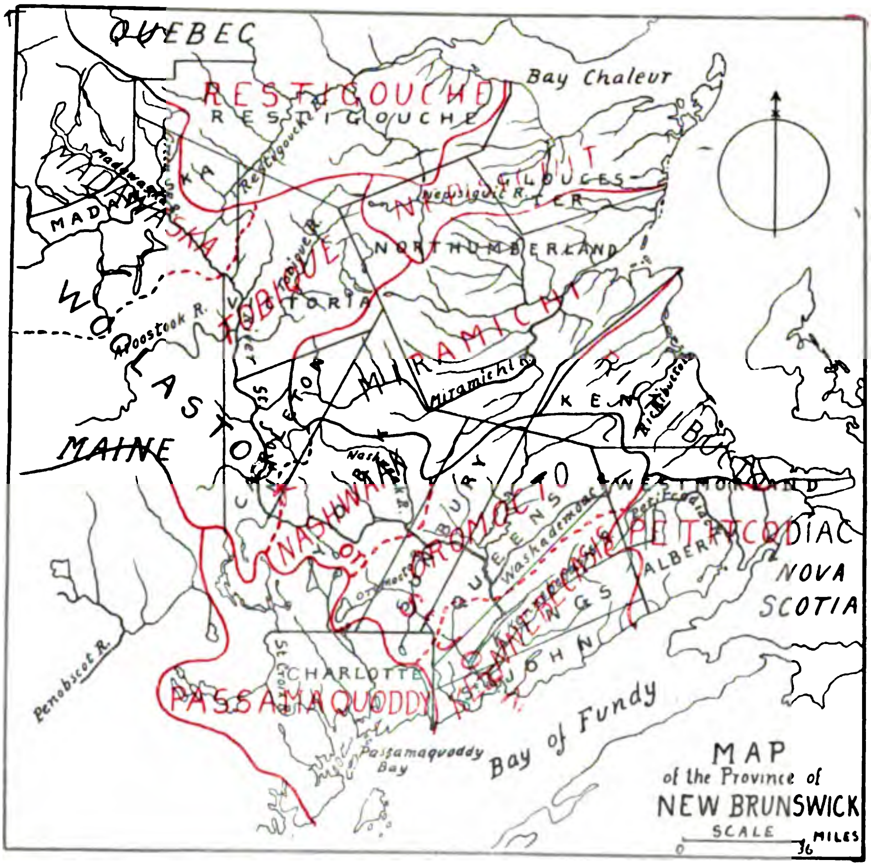

QUEBEC
Bay Chaleur
RESTIGOUCHE
RESTIGOUCHE
MADAWASKA
MADAWASKA
GLOUCESTER
Nepisiguit R.
NORTHUMBERLAND
VICTORIA
WOLASTOK
TOBIQUE
MIRAMICHI
Miramichi R.
KENT
MAINE
NASHWAAK
OROMOCTO
PETITCODIAC
Washademoac
QUEENS
KINGS
ALBERT
NOVA
SCOTIA
ST. JOHN
CHARLOTTE
PASSAMAQUODDY
Penobscot R.
Passamaquoddy Bay
Bay of Fundy
MAP
of the Province of
NEW BRUNSWICK
SCALE
MILES

Fig. 1.

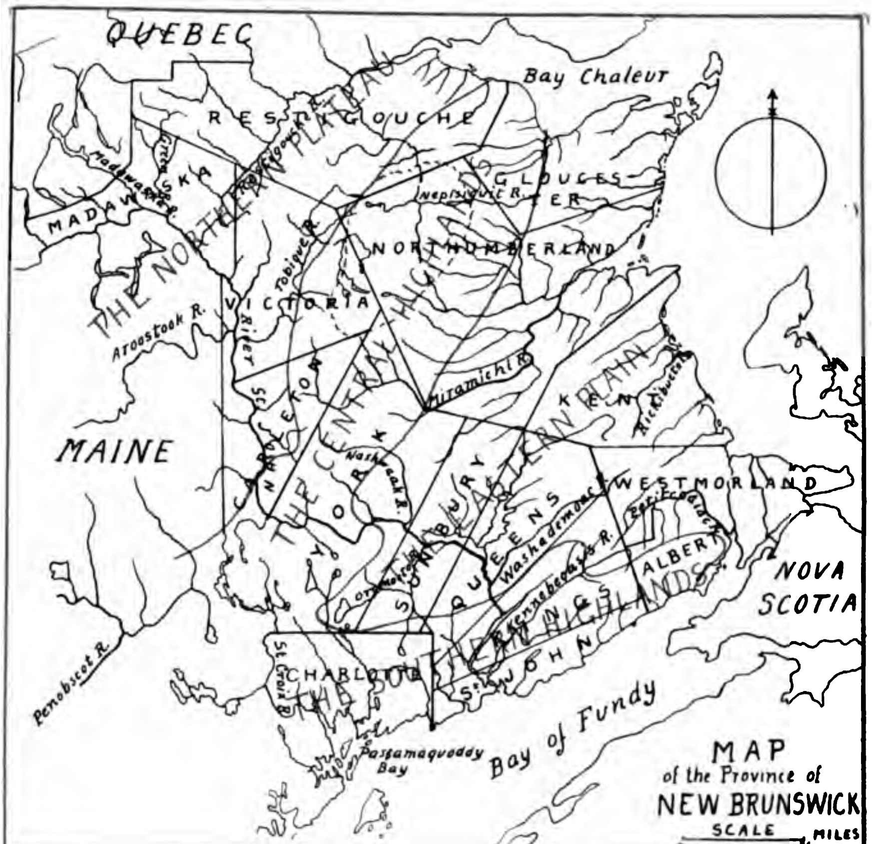

QUEBEC
Bay Chaleur
RESTIGOUCHE
MADAWASKA
GLOUCESTER
NORTHUMBERLAND
VICTORIA
THE NORTHERN PLATEAU
THE CENTRAL HIGHLANDS
THE EASTERN PLAIN
THE SOUTHERN HIGHLANDS
Aroostook R.
Miramichi R.
KENT
MAINE
CARLETON
YORK
SUNBURY
QUEENS
WESTMORLAND
KINGS
ALBERT
NOVA SCOTIA
ST. JOHN
CHARLOTTE
Penobscot R.
St. Croix R.
Passamaquoddy Bay
Bay of Fundy
MAP
of the Province of
NEW BRUNSWICK
SCALE
MILES
0
36

Fig. 2.

Since however it is far too great to be treated as a unit, it may be subdivided as follows :

A. *The Madawaska Sub-district.* Includes all north of a line separating Grand River and Little River, crossing the St. John at Grand Falls, and separating the Fish River and Aroostook system.

B. *The Tobique (or Carleton-Victoria) Sub-district.* Includes all north of a line separating Becaguimec from Nacawicac and Nashwaak, and Eel River from Sheogomoc, crossing the St. John on the edge of the granite at Middle Southampton.

C. *The Nashwaak (or York Sub-district .* Includes all north of a line between the Little River and Nashwaak systems and between the Oromocto and Longs Creek, crossing the St. John with the County line.

D. *The Oromocto (or Queens-Sunbury) Sub-district.* Includes all north of a line between Belleisle and Washademoak and between Nerepis and Oromocto, crossing the St. John with the County line.

E. *The Kennebecasis (or St. John-Kings) Sub-district.* Includes all south of the preceeding to the Bay of Fundy.

III. *The Petitcodiac (or Westmorland-Albert) District.* Includes the basins of all rivers falling into the Bay of Fundy and Baie Verte from Martins Head to Cape Tormentine. The County line might seem a more logical division between this and the Woolastook district, but Martins Head is so much more natural that it would seem better to adopt it as the division point.

IV. *The Richibucto (or Kent) District* Includes the basins of all the rivers from Cape Tormentine to Point Escuminac.

V. *The Miramichi (or Northumberland District).* Includes the basins of all rivers from Point Escuminac to Barreau Point (between the Tabusintac and Tracadie.)

VI. *The Nepisiguit (or Gloucester) District.* Includes the basins of all rivers from Barreau Point to Belledune Point, including Miscou and Shippegan.

VII. *The Restigouche District.* Includes all north and west of Belledune Point. Belledune Point gives a more natural division than Little Belledune Point, near which the County line starts.

The above division of the province by river basins will probably be found most useful for purposes of detailed description of provincial phenomena, and of local history, etc.; but a more strictly natural one, taking account of the geology and accompanying topography, will be needed for some purposes. Unfortunately, as stated above, our geology appears too complicated to admit of a very detailed division of the province upon this basis. A general natural division is, however, possible, as shown on figure 2. Although the geological boundaries

are fairly distinct, the accompanying topography is not, and, hence, sharp lines are impossible, and the boundaries shown on the map are only approximate. The divisions may be named as follows :

I. *The Northern Plateau*, including the great Upper Silurian Area of the Northwestern part of the Province, with Lower Carboniferous outliers on its margin in places, forming mostly a great peneplain 800 to 1000 feet above the sea.

II. *The Central Highlands*, of Archaean Felsites and of Granite, bordered by Cambro-Silurian Slates, consisting of irregular ridges, forming the axis of the Province, and culminating in the high hills, 2000-2700 feet above the sea, between the headwaters of the Tobique, Nepisiguit and Miramichi.

III. *The Eastern Plain*, of Carboniferous bordered by Lower Carboniferous sandstones. This is a peneplain, is highest in its western part and slopes off to the eastward where it is low and level.

IV. *The Southern Highlands*, also of ridges of Archaean Felsites and of Granites intermixed with Silurian and Devonian rocks reaching heights up to 1400 feet, and merging in Charlotte with the Central Highlands. This may perhaps better be called *The Southern Ridges*.

27.— On a marked Browsing-effect observed near St. Stephen.

(Read May 2nd, 1899).

Five miles below St. Stephen, on the peninsula between the St. Croix and Oak Bay, is a high granite hill, called locally Dickie's Mountain. It is notable for the supurb view it commands, and is recorded in the Society's Bulletin as the best mapped hill in New Brunswick (Bulletin No. XVII, page 123). The top is largely bare rock, but bears here and there small spruces, many of which attract attention through their unusual form, for they are hour-glass shaped, or at times like two cones, with the base of one resting upon the apex of the other (see the third in the accompanying Figure 3). The lower cone is the most symmetrical, extremely dense, and always approximately of the same height, as the axe introduced into the three figures will show. The upper cone may be absent altogether, or developed in various degrees, and is always loose in structure, and quite like any other spruce. One is at first inclined to ascribe the appearance to clipping by man, or to some growth conditions peculiar to the locality, but it is no doubt a marked kind of browsing effect. The place is a sheep pasture, and these animals probably bite off the young terminal

buds in spring, forcing the plants to branch profusely, as a hedge does when clipped. This is confirmed by the broken appearance of the tips of the branches. The sheep browse as high as they can reach, but finally the main terminal bud gets beyond them and thenceforth develops

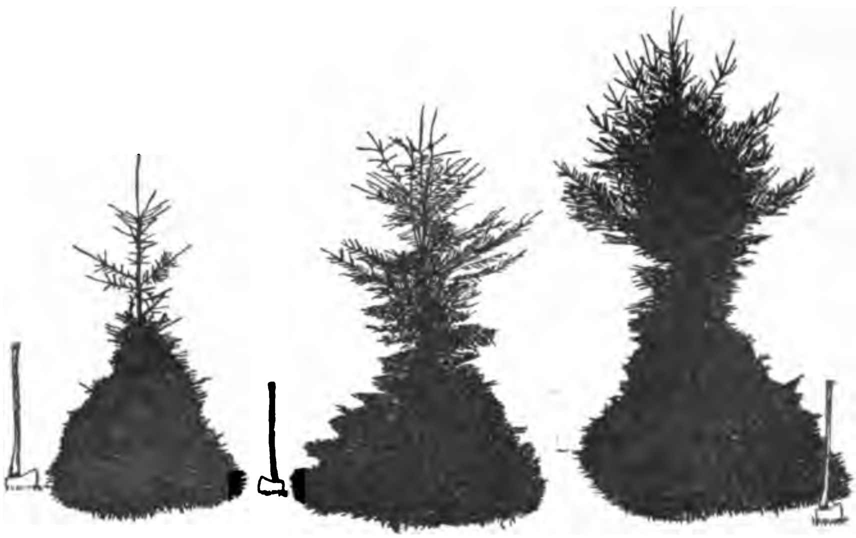


FIG. 3. Browsing effect upon spruces.

normally. Three stages in the development of the upper cone are shown in the three accompanying figures which are traced from photographs, and therefore are accurate. No doubt this effect is common enough, though I have seen it in but two or three other places, and never so perfectly as here.

28.—An Optical Illusion on the Peat Bogs of Charlotte County.

(Read June 6, 1899)

In a paper on "Raised Peat-bogs in New Brunswick," published two years ago (Trans. Royal Society Canada, new series, III, sec. iv, 150) I pointed out what seemed to be a rising and sinking of the surface of the Lepreau bog to an extent of several inches, under the influence of weather conditions which I could not determine. The only rule about the movement seemed to be this, that it rose in bright and fell in dark

weather. In a letter dated July 1st, 1898, Dr. C. Weber, of Bremen, Germany, a distinguished authority on Peat-bogs, gives me an entirely different, and doubtless correct, explanation of the phenomenon which he illustrates by the accompanying figure (Fig. 4). He shows that it

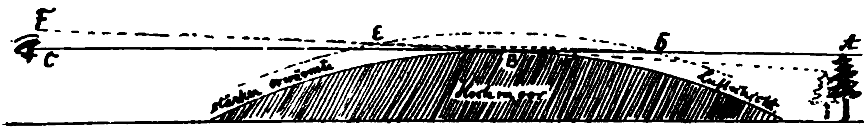


FIG. 4. Diagram of rays over a raised peat bog in dark and bright weather. Hochmoor — raised bog: B — its highest part. Stärker erwärmte Luftschicht — more strongly warmed layer of air.

is an optical illusion, caused as follows: if in dull weather, the eye of an observer standing near the margin of the bog (*i. e.*, C. in Fig. 4), be at such a height that the top of some object on the opposite margin is just visible, (*i. e.*, A) the ray from one to the other will be straight. If now, the sun appears, the layer of air in contact with the bog will become more strongly warmed than the layers above it, and hence it will become rarified and less refractive. When the ray from the object reaches this layer, it passes into a less dense medium and hence bends from the perpendicular, *i. e.*, away from the surface of the bog (*i. e.* from *b* to E). In issuing from this layer, it re-enters the denser layer, and hence it will be bent towards the perpendicular, and therefore still farther upward from the surface (*i. e.*, from E to F). Consequently the ray will pass over the head of the observer (to F), who, finding it necessary to rise vertically some inches to again see the object, naturally thinks the bog itself has risen.

29.—ON THE PHYSIOGRAPHY OF THE NICTOR LAKE REGION.

(Read December 5th, 1899).

At the eastern head of the Tobique River, in the north of the New Brunswick Highlands, lies Nictor, fairest of New Brunswick lakes. It is absolutely wild, unvisited save by an occasional sportsman or naturalist, and may be reached only by a several-days' canoe journey. It is unsurveyed, wrongly mapped, and scientifically little known. For these reasons, the following observations, made during two visits

to the lake in 1898 and 1899, will doubtless be acceptable; and because of the great interest of the place, I shall try to make my account monographic.

History. The lake makes its first appearance in historical records upon Franquelin's fine map of Acadia, of 1686, (Fig. 5, A). He does not name the lake, though he marks the portage to Nepisiguit (Oniguen is the Maliseet *Oonegun*—a portage), and he names the Little Tobique, *Nipisigooichich*, or Little Nepisiguit, probably its

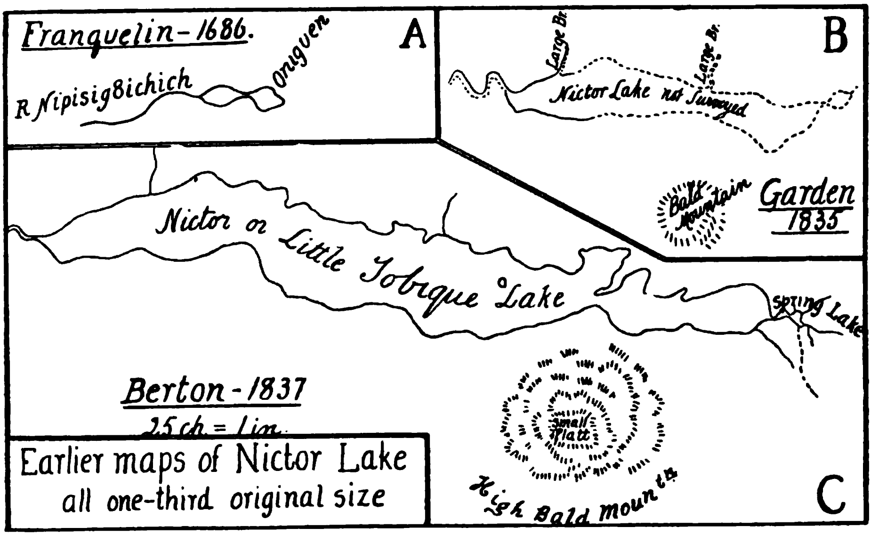


FIG. 5. Early Maps of Nictor Lake.

Micmac name. How remarkably this map influenced all others of this region for over a century, I have elsewhere traced.* The lake next appears, though very imperfectly, upon the fine engraved Baillie and Kendall map of 1832; but it was first sketched by a surveyor in 1835, when Garden made the MS. map shown herewith (Fig. 5, B). In 1837 Deputy Berton made the MS. sketch shown in Fig. 5, C, which is the original of every published map of the lake down to the present day. In August, 1899, I made a survey of the lake, the first

* Trans. Royal Soc. Canada, new ser., III., ii., 364, where the New Brunswick part of the map may be found.

ever made, resulting in the accompanying map (Fig. 6). I used a fair prismatic compass, and a simple home-made apparatus on the stade principle for measuring distances; the general shape must be nearly accurate, though its proportions may be somewhat in error.*

The lake must have witnessed events of no small interest, but these are unwritten and lost. It was one of the most ancient and frequented highways across the province, and has seen the passing of warriors, hunters, missionary priests, traders, grand seigniors, governors and scholars. It was probably somewhere in this vicinity that the good Father Bernardin perished on his way from the Nepisiguit to the St. John, in 1621, as related by LeClercq. The first mention of it in print that I have found is in Wightman's report on barometric measurements, made in 1839, contained in a British boundary Blue-book of 1840. Governor Head was here in 1849, as Gordon tells us, but he left us no account of his travels. Governor Gordon came in 1863, and has left us in his "Wilderness Journeys" a most interesting account of his impressions, as well as the first printed description of the lake. He admired it as possessing "more beauty of scenery than any other locality I have seen in the province, except, perhaps, the Bay of Chaleurs," meaning, of course, the head of the Bay, above Dalhousie. He gave to Bald Mountain the name Sagamook—(mount of chiefs)—which it still bears. Later in the same year Professor L. W. Bailey visited the lake, and has given us our first scientific notes upon it, particularly its geology.† Since then Messrs. Hind, Ells, Chalmers, and Hay, have briefly visited it with results contained in well-known reports.‡ There are references to Nictor Lake in various reports, guide books, sporting books, etc., but I believe the above-mentioned include all real sources of information. Nearly every writer, from Gordon to the present, speaks of the beauty of the lake.

Place-Nomenclature. On the map (Fig. 6) are two sets of names, one in Roman letters, including those already more or less in use (for a list of which I am indebted to Mr. George Armstrong, of Perth Centre), and another set in italics which now appear for the first time. The latter I have myself given, for reasons and upon a principle fully set

* I was accompanied and aided by my brother, Mr. Arthur Ganong. The preceding summer I was with Mr. G. U. Hay, who has described our trip in this Bulletin (XVII. 153).

† In his "Report on the Mines and Minerals of New Brunswick," (1864), and also in his "Notes on the Geology and Botany of New Brunswick," (Can. Nat., 1864).

‡ Geological Reports: this Bulletin IV, 104.

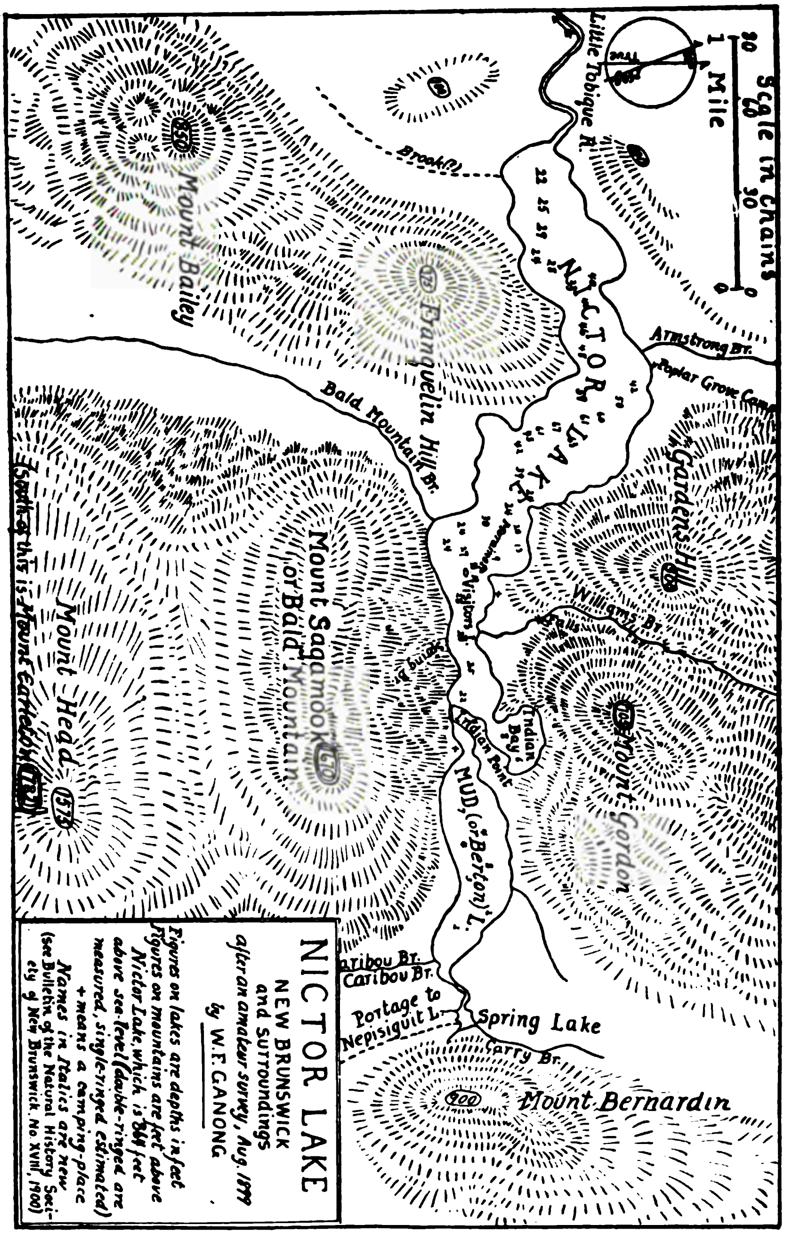


Fig. 6. Map of Nictor Lake.

forth in the next note of this series (No. 30). Most of them are sufficiently explained by the facts given in the preceding section, *i. e.*, they commemorate those who have been in some way closely connected with the history of the lake. Moraine Island describes its formation as a glacial moraine. Nictor is a corruption of the Maliseet Nictau,

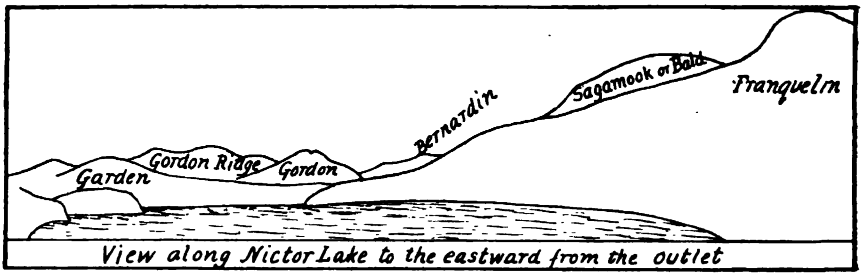


FIG. 7.

meaning Forks, and applied by the Indians to the main forks of Tobique. It was extended to the Little Tobique, and then to the Lake.

Description. The most striking and charming feature of Nictor consists in the splendid forested hills among which it winds. In the beauty of its hill scenery no other lake of the province can compare with it. The hills are highest towards the east (their heights are upon the map), and as one enters from the Little Tobique he sees the fine range

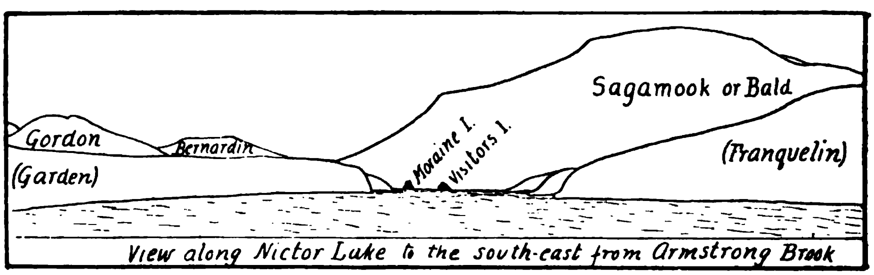


FIG. 8.

crudely shown in Figure 7. This figure will be sufficient to admit of their identification, but gives no conception of their real grandeur. In some respects they show yet better from farther up the lake (Figure 8), and here the stately form of Sagamook shows to best advantage. Best of all, however, are the views from the little island under Saga-

mook, from which all the prominent hills about the lake are visible. The view to the east is the finest (Figure 9), but to the west it is little inferior (Figure 10). Above all and over all, however, towers grand Sagamook. Rising steeply over sixteen hundred feet directly from the lake, higher than any other New Brunswick hill rises from the water, clothed with living forest, except for a few bold bosses near

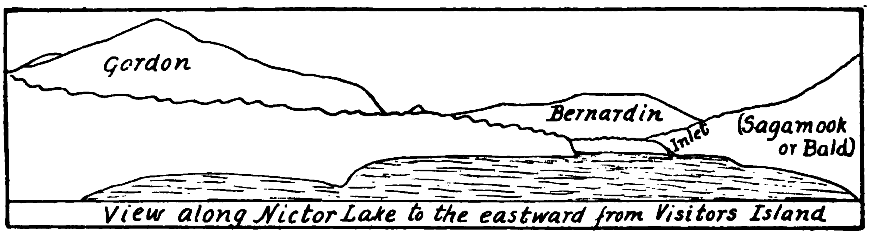


FIG. 9.

its summit, shrouded often in mists, it is easily the finest, even though not the highest, of New Brunswick hills. Happy is he who, from the ideal camping place upon the island, can watch day after day these beautiful hills in their varying lights and colors, and can know they are his own.

Next in charm to the hills is the virgin forest which clothes them. This is everywhere entirely unbroken, except for the few naked spots

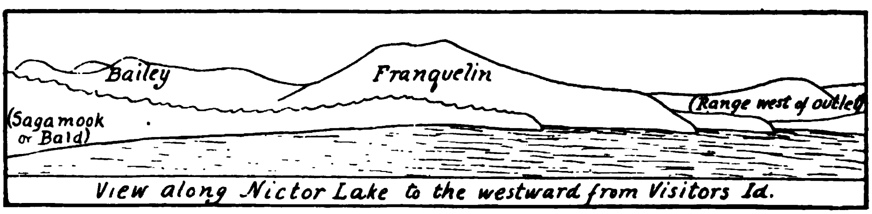


FIG. 10.

near the summit of Sagamook. There is no trace of fire, nor of the lumberman. Probably in no accessible part of the province is there a finer forest, or one more nearly primeval than this. It is of the mixed growth of our common provincial species, and it is a fine sight to see the splendid spruce in sombre green towering above the level of the brighter green hard woods. This forest owes its preservation to the expensiveness of driving lumber down the crooked Little

Tobique. But the shadow of the deadly pulp-mill already looms over it, and its glory will soon depart.

This forest is extremely rich in game, especially moose and deer. The lakes contain many trout and other fish, though in this respect they are inferior to the Nepisiguit lakes.

Physiography. The lake is 864 feet, more rather than less, above mean sea level. Its maximum depth is 67 feet, surprisingly little for a hill lake.* This depth diminishes to only 28 feet directly under Sagamook, and lessens eastward so that Mud or Berton Lake, separated from Nictor only by a morainic ridge and connected with it by a short brook falling from one to two feet, is but a few feet deep, though it is made thus shallow by deposits of organic mud similar to that found in so many of our "mud lakes."† The shores of Nictor are usually bold and rocky, but in places the shores are of loose morainic materials, and but rarely of gravel or sand. There are but two islands, one of them narrow and low, apparently a moraine, and the other of highly tilted slate rising abruptly from the bottom. The latter bears a few trees and bushes, and forms the most charming camping-ground that I know of in New Brunswick. Four large brooks flow into the lakes, of which two, Bald Mountain and Caribou, flow in broad deep valleys, which are doubtless the courses of ancient rivers. Williams' Brook is new, and has upon it, not far from the mouth, an irregular fall of some eight feet, whose murmur can be heard from afar on still days, and the mist from which in certain weathers hangs like smoke over the slope of Gordon. A striking place is Spring Lake, practically an immense spring with a summer temperature of but 41° or 42°. The lakes empty by the Little Tobique, a very winding stream of much, though rather monotonous, beauty, but perfectly ideal for the amateur canoeman.

Origin of the Lake. I believe the lake occupies an ancient valley of erosion choked by glacial drift. As I shall show in a later note, the entire upper valley of the Nepisiguit is very ancient, and it could not have emptied by its present course. It probably therefore ran into Nictor Lake by way of the portage valley now followed by Caribou Brook. The valley of the Little Tobique, though perhaps post-glacial

* The deepest known lake in New Brunswick is Clear Lake, Lepreau, 78 feet (this Bulletin, XIV, 48).

† This Bulletin, XVII, 126.

in spots, is certainly pre-glacial as a whole. By its extension back the lake was doubtless robbed from Mamozekel waters, into which it once probably flowed along the low valley now occupied by Bald Mountain Brook.

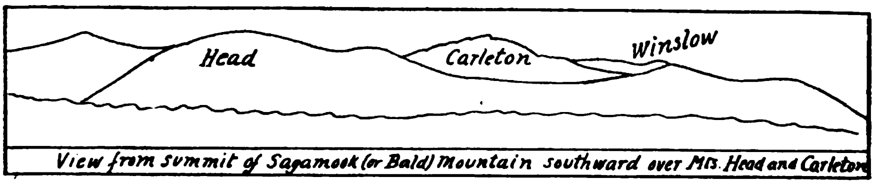
The geology, as traced in general by Bailey, Ells, and Chalmers, is shown upon the geological map. All the large hills about the lake and its entire eastern end are of Pre-cambrian felsites, but Silurian rocks appear at the western end. One very remarkable fact about the geology of the lake, first referred to by Bailey, is the presence of the little island of slate, Visitor's Island, completely surrounded by felsites. It may represent the remanant of a tongue of Silurian rocks extending along the bed of the lake to this point, which would give a great age to this valley. The island slopes down so steeply and abruptly on the north side as to suggest a fault running along the axis of the lake. Were it not for its relatively enormous size, 100 feet long by 50 wide, one would be tempted to view it as simply an enormous boulder. But this is but one of the very many attractive problems awaiting solution in this region.

Natural History. No study whatever has yet been made of the zoology of the region, and but little of the botany.

The Neighboring Highlands. To the north of the lake the mountain ranges appear irregular, and I have not tried to work out their particular arrangement. On the southern side, however, they are as follows: Sagamook is not an isolated mountain, but is the northernmost of three parallel ridges forming together a great island or plateau of felsite (see map, Fig. 6, and also the map accompanying the next note, Fig. 13). This plateau has Nictor Lake on the north, the deep valley of Caribou Brook and the portage on the east, Bald Mountain Brook valley on the west, and a valley between Nepisiguit Lakes and the Mamozekel on the south. Sagamook is separated from the next ridge, Mount Head, by a valley not over 300 feet deep, while a somewhat deeper valley lies between Head and Mount Carleton. The appearance of Head and Carleton from Sagamook is shown by Fig. 11. Mount Carleton is over 100 feet higher than Sagamook, and is easily recognized by its bold, bare, saw-like top. Still farther to the southward one can see the summit of Mount Winslow, not a part of this plateau (Fig. 12). On the westward of the valley of Bald Mountain Brook runs a fine range of hills south-west. It begins at Nictor Lake

with Franquelin; next is Bailey, and then follows a series of six or more crests, which are to be named for the geologists who have investigated the structure of the province, and which, therefore, may well be called the Geologists' Range. But on these matters future communications will be made to the Society.

The impression of this plateau which one gains by viewing it from either Nictor or Nepisiguit lakes is extremely misleading. Thus

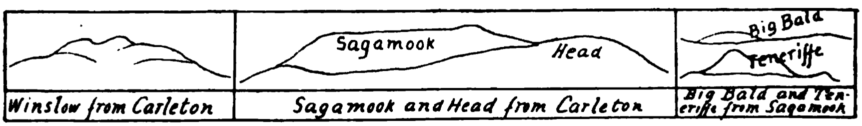


View from summit of Sagamook (or Bald) Mountain southward over Mts. Head and Carleton

FIG. 11.

the summit of Mount Carleton is not visible at all from Nictor Lake nor from the Upper Nepisiguit Lake, though it is from the Lower Nepisiguit Lakes. Again, the summit of Sagamook is not visible from the Upper Nepisiguit Lake, but only from the lower lakes. It is only by visiting the summits of these mountains and comparing the different views thus obtained, that one can gain a correct knowledge of their relationships.

A great charm of these mountains is the view from their summits. That from Sagamook is particularly grand. From the naked bosses



Winslow from Carleton | Sagamook and Head from Carleton | Big Bald and Teneriffe from Sagamook

FIG. 12.

at the west end one can look away over the rolling Silurian plateau to the mountains of Quebec and Maine, while from the highest point of the mountain, a bare place near the eastern end of the ridge, one can see far off to the north and east, and the fine range of mountains through which runs the Nepisiguit, and the great mass from which rises Big Bald on the South Branch. But even these views are sur-

passed by those from the summit of Mount Carleton,* for here from one spot the eye may range without hindrance in every direction, and there cannot be a grander outlook over a more rugged country anywhere in this province. Everywhere lie the splendid hills with innumerable crests, as if the sea, with its rollers and breakers were suddenly stilled to stone. They stretch away vast, silent, patient, as unvexed by the little affairs of man as by the shadows of the summer clouds floating above them. They are nearly all forested and unburnt, a great contrast with most other parts of the province. As one stands upon the summit of one of these rarely-visited hills on a fair summer's day, and looks upon these unspoiled hills and forests, the very rugged foundations of his native land, he cannot but feel an exaltation which is one of the best joys of life.

Nictor Lake, therefore, lies to-day not only by nature the most charming place in the interior of New Brunswick, but as yet entirely unspoiled. But the doom of the summer hotel even now threatens its shores, and the pulp-mill its forests. But why should not the people of New Brunswick prevent its despoiling, and set aside the lake and its shores as a provincial park, to be kept wild and beautiful for their enjoyment forever? It can be sacrificed for a small present profit, or saved for a large one in the future. But there is another reason for the preservation of the lake region. In the very near future New Brunswick must turn her attention to systematic forestry, or else lose her chief source of wealth, and resort to direct taxation of her citizens. The first step towards such forestry must be the setting aside of certain areas to be managed on good principles, as a nucleus for forestry extension, and for instruction in forestry management. Nowhere in the province in an equally accessible place is there so fine a forest as here, or one which it would be easier to manage on correct principles. Various states of the United States are making reservations about the heads of their principal rivers for the purpose of preserving forest and game and water supply, as well as for wild parks. Let us be warned in time and set aside here a forest and game preserve and wild park for the future instruction and enjoyment of our people.

* Mount Carleton is most easily reached from Nictor by taking a compass line to it from the highest point of Sagamook.

30.—PROPOSALS FOR A NOMENCLATURE OF UNNAMED NEW BRUNSWICK HILLS AND MOUNTAINS.

(Read December 5th, 1899).

It is a fact that the great majority of New Brunswick hills and mountains, including some of the very finest, are to-day quite nameless. In the settled districts, it is true, they are mostly named, but most of New Brunswick is unsettled. This seems the more remarkable when it is recalled that practically all of our streams and lakes, even to small brooks and ponds, and in the wildest parts of the province, are named. But for this the reason is plain. Our water-courses have a relation to our interests through their use for lumbering, hunting and fishing; hence they must often be spoken of, and names for them arise. But our mountains only exceptionally affect our interests in these or other ways, hence are rarely spoken of, and names do not arise for them. Such is the condition at present, but it will not always be so. As the province becomes settled, as hunters and tourists visit it more, as a provincial literature arises, as forestry becomes systematized, as maps become more accurate and detailed, as scientific explorations become more extended and minute, a need for names for our mountains will be felt, and they will gradually come into use. Unless, however, some broad and consistent plan for the giving of such names be adopted, those which will arise will be often of the most trivial, inappropriate and inconvenient sort. One has only to instance the very numerous and confusing Bald Mountains.* Is it not possible to inaugurate some plan which will provide for our mountains a convenient, appropriate and pleasing nomenclature? Certainly such a matter is eminently one for consideration by this Society.

If now, we pass to details, three questions arise: first, what kind of names should be given; second, what shall determine the adoption of proposed names; third, how may they be introduced into general circulation? We may most conveniently consider these questions in reverse order.

How may names, deliberately given, be introduced into general circulation? Guides, lumbermen, and most others who are much in

* Attention was first called to incongruities and inconveniences in our place-nomenclature by Professor Bailey (Mines and Minerals of N. B., 1864, pp. 8, 9).

the woods, make no use of maps, but adopt names only as they hear them, or as they arise naturally from the fixation of descriptive phrases, the method by which nearly all place-names arise among uneducated people. Yet such people, as I have often observed, have great respect for maps, and for their "correct," *i. e.*, printed names; and undoubtedly they would adopt them when brought to their attention, for otherwise unnamed places, provided only they are pronounceable and familiar enough in form to be easily remembered. But surveyors, tourists, hunters, scientists, and the better class of guides, do use maps, and unhesitatingly adopt their names. The number of such visitors to our mountains is increasing, and if the new names are on the maps used by them, they will be adopted; the guides will then hear them and pass them to others, and so on, until in time they will become widespread and fixed. The great practical point, then, is to secure their insertion upon all new maps, not only upon geological and other scientific maps, but upon all those issued by the Provincial and Dominion governments. If the Society approves of this plan, and will use its influence to urge the adoption of these names in all official publications, setting the example in its own publications, it will go far to secure this desirable end.

We next consider what shall determine the names to be adopted. I would suggest that such names be adopted and approved by the Society as are given upon the same principles as are recognized among scientific men for the naming of new species of animals or plants; that is, the first name applied to a previously unnamed place shall be accepted when published with such a description and illustration as will enable any other person to recognize it. The illustration should be a drawing, or better a photograph, or a survey (not a sketch) map accurately locating the place.

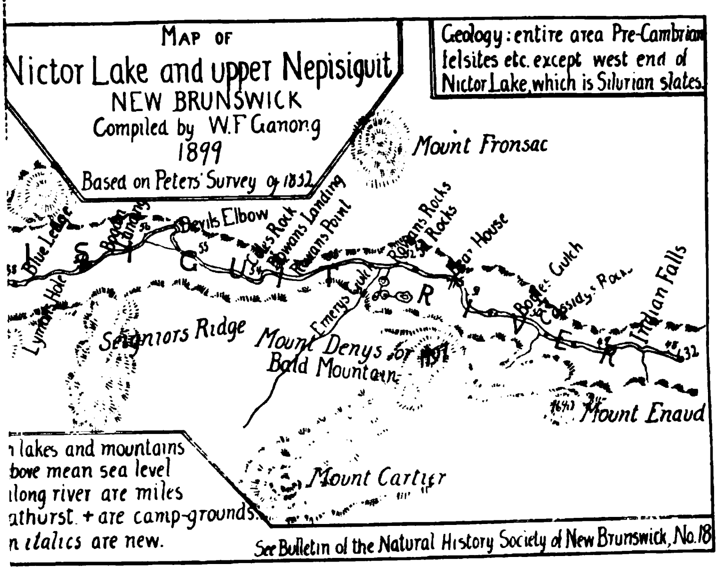
We ask, finally, what kind of names may best be given? Here we are much aided by taking account of the known qualities of the best place-names. The best names are, first, *melodious*, that is, they have a well-balanced succession of a few pleasing easily-pronounced sounds; second, they are dignified, that is, are free from incongruous associations, and have sounds consistent with the character of the place; third, they are individual or unique, that is, are applied to but a single place, and not met with elsewhere. Few names can realize all of these qualities, but they put before us an ideal to be striven for.

As to the actual words chosen, they may be drawn from any one of several classes. First, there are descriptive names; but these are good only when they describe some striking and easily-recognizable quality of the place, and are such as are not likely to be in use or to be adopted elsewhere. Our mountains, however, are not unlike enough to one another to make many such names available. Then there are Indian names, especially when these are familiarized into an easily pronounced form. Unfortunately, however, our Indians appear rarely to have had native names for mountains, and this, of course, for much the same reason that their white successors have none. Again, names may be drawn from those of persons or events prominent in the early history of the province. In these we have a great store of pleasing, easily-pronounced, already more or less familiar, words; and, as to their appropriateness, it is surely fitting that the names of those who have laid the foundations of the province should be lastingly commemorated in her eternal foundation hills. Most of our new names will probably be drawn from this source. Of course such names will be applied, as nearly as possible, to places associated with the person or event commemorated. It is a fact, too, that more honor would be done a person by naming for him a smaller mountain in an accessible and much visited place, than a larger one in a place inaccessible. There should be, too, some proportion between the importance of the place and the prominence of the person commemorated; the greater hills should be named only for those of provincial prominence, while the smaller may well be devoted to the names of those whose importance is only local.

With the convictions here expressed, and following the principles here recommended, I have ventured to apply names to the more prominent mountains about Nictor Lake and along the upper Nepisiguit. This region includes some of the highest, and perhaps scenically the finest, of New Brunswick mountains, and is withal fairly accessible.

About Nictor Lake is a particularly fine series of hills, described and figured in the preceding note (No. 29). The map accompanying that paper, as well as the one with this, show all new names in italics.

Mount Bernardin is named for the Recollet Missionary, who, about 1621, perished of cold and hunger somewhere in this vicinity while on his way from the mouth of the Nepisiguit to the St. John. *Franquelin* is for the great French cartographer, who was the first, in


MAP OF
Nictor Lake and upper Nepisiguit
NEW BRUNSWICK
Compiled by W.F. Ganong
1899
Based on Peters' Survey of 1832
Geology: entire area Pre-Cambrian felsites etc. except west end of Nictor Lake, which is Silurian slates.
Mount Fronsac
Devils Elbow
Blue Ledge
Lyman's Hole
Seigniors Ridge
Mount Denys or Bald Mountain
Emerys Gulch
Bowans Landing
Indian Falls
Mount Enaud
Mount Cartier
n lakes and mountains
bove mean sea level
long river are miles
athurst. + are camp-grounds.
n italics are new.
See Bulletin of the Natural History Society of New Brunswick, No. 18

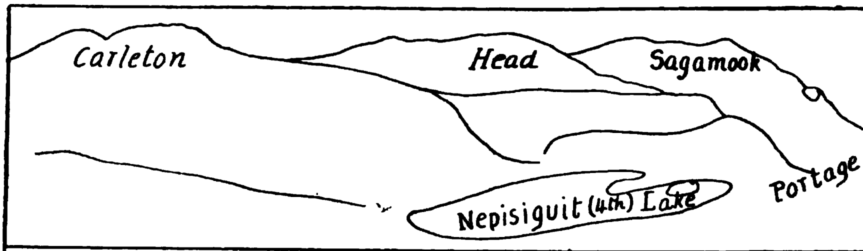
90 feet.

1686, to place Nictor Lake upon a map. *Garden* is for the surveyor who, in 1835, was the first to sketch a modern map of the lake, and to apply the name Nictor to it. *Berton* (lake, not mountain), is for the other surveyor who, in 1837, made the sketch map which has been the original of all published maps of the lake even to the present day. *Head* is for a governor of the province who was here in 1849 and named Mount Teneriffe. *Gordon* is for another governor, whose charming book, "Wilderness Journeys," published first in 1864, gives the first published description of the lake. It was he who named Mount Sagamook. *Bailey* is for the naturalist, Professor in the University of New Brunswick, who gave us, in 1864, the first scientific account of the geology and botany of this region. *Carleton*, applied to what is much the highest mountain in this part of the province, and possibly in the entire province, is named for Thomas Carleton, governor of New Brunswick from its foundation in 1784 until his death in 1817. Mounts Carleton, Head and Sagamook form a plateau, which, since its peaks are named for two governors, and by another, may well be called *The Governors' Plateau.* In Nictor Lake lies a little island named from its mode of formation, *Moraine Island.* South of Carleton lies another high and conspicuous mountain named *Winslow*, in honor of Edward Winslow, who was so closely associated with the foundation of the Province of New Brunswick, and who is as yet uncommemorated in any place-name.

As one stands upon the western end of Sagamook, he can see running off to the southwest a fine range of very prominent hills, with several rounded summits. This range begins with Mount Bailey and terminates near Bald Head, south of the Tobique. Since Bailey is one of the range, the other summits may well be named for the other geologists who have worked in this province, *Gesner*, *Robb*, *Hartt*, *Matthew*, *Dawson*, *Ells*, *Chalmers*, and the range may well be called the *Geologists' Range.* No maps or figures are here presented, for I hope soon to give it further study.

We pass next to Nepisiguit waters, of which a map is given herewith (Fig. 13), and we may well commemorate in its numerous grand hills those who have been prominent in the history of the river and the region of the North Shore about its mouth. We come first to a large lake. It first appears on the excellent map of 1685 by the Recollet missionary, Jumeau, as *L. aucler*, and the name is restored.

From no part of this lake can the summits of Sagamook or Carleton be seen, nor, of course, can the lake be seen from their summits, but they can be seen with great distinctness from near the summit of Teneriffe (Figs. 14, 15). In addition to those already mentioned, one sees a low rounded hill, which shows more distinctly from the lower end of the lake, named for *Jumeau*, the lake's first cartographer. To

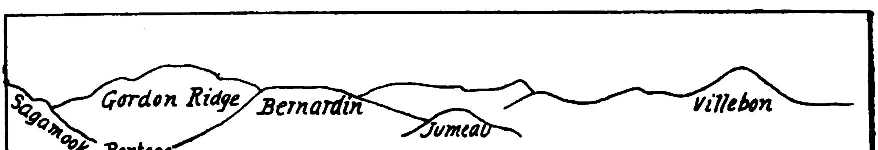


View of the Governors Plateau westward from near summit of Teneriffe

FIG. 14.

the northward stands up a splendid very high rounded dome, falling outside the limits of the map, but shown in Fig. 15, easily seen from Sagamook and from other directions, which is named *Mount Villebon* in honor of the most prominent of the French governors of what is now New Brunswick when it was a part of Acadia.

Below Aucler are three other shallow lakes, from the eastermost of which an arm, forming another lake, runs to the southward. This is



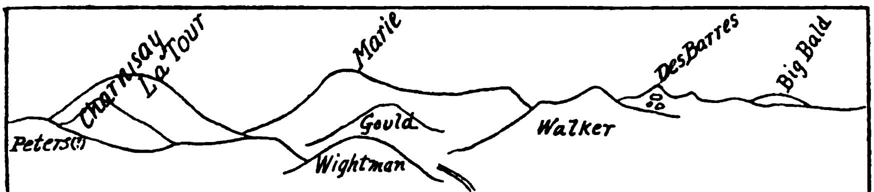
View northwest from near summit of Mount Teneriffe

FIG. 15.

remarkable for its great deposit of diatomaceous earth, described in an earlier note (No. 17), whence it may be well called *Diatom Lake*. South of these lakes and parallel with them runs a splendid ridge, known appropriately to the lumbermen as the Green Range. It is, I think, continuous with Mount Winslow, but I am not sure of this.

South of it stands Mount Teneriffe, from which a fair view may be obtained to the westward (Figs. 14, 15), and a particularly grand one to the eastward (Fig. 16). From here two mountains falling outside the limits of the map show up with particular distinctness, the round dome of Big Bald on the south branch of Nepisiguit, and to the left of it a pointed mountain with three bare spots near its summit. The latter is named *DesBarres* for the man, afterwards governor of Cape Breton, who first thoroughly surveyed our coasts, and who mapped, in 1780, the interior of New Brunswick far better than any other cartographer until well into this century. This is, I think, the mountain shown on the geological map at the forks of the south branch of Nepisiguit (just west of the large N).

We begin now to descend the river. As in other rivers of the province the lumbermen have a nomenclature of their own for the



View to the Eastward from the summit of Teneriffe

FIG. 16.

rapids, rocks, points, etc., along the river, and these names (for much help in compiling which I am indebted to Mr. P. J. Burns, M.P.P., of Bathurst,) are given on the map. As to the mountains, the first we meet is the symmetrical hill around which the river flows, which may well be named *Mount Cooney*, in honor of the author of the "History of Northern New Brunswick and Gaspé," (1832), in which is found the first, and, on the whole, an accurate description of the river. Northeast of this is a prominent symmetrical mountain, which is named *Mount Peters*, for the surveyor whose accurate map of the river, made in 1832, is the basis for all subsequent maps. From the forks of the Little South Branch three fine mountains may be seen at once, one of which was named Felspar Mount by Professor Bailey in 1863, and on the slope of which he describes a remarkable chasm. That to the east of it is named *Mount Walker* in honor of Commodore Walker, who was the first English settler at the mouth of the river,

where in 1768–1776 he had a large trading establishment described by Cooney. The rounded mountain just north of the river here is named *Mount Wightman*, for the surveyor of Fredericton who, in 1839, carried a line of barometric measurements through this region for the British government, as described in a Boundary Blue Book for 1840. Farther down on the south bank is a distinct, though not a high hill, which should be named *Mount Goold* (on the map, by mistake, Gould), for Arthur Goold, who at one time owned the site of Bathurst and attempted to make a settlement there. Lower still, on the north bank, towers up a splendid symmetrical rounded mountain, prominent in the landscape from both up and down river (see Figures 16, 18), showing from the west a marked red color; this is named *Mount LaTour* for the Sieur de LaTour, so well known in our provincial history. Just west of it is another of similar character, but not so large, and more deeply stained with red, and this is named for *Charnisay*, his rival. Directly south of LaTour, across the river, is a splendid wooded ridge, as high as or higher than LaTour itself, and as prominent, but of softer and more pleasing character, which is named *Mount Marie*, for our Provincial heroine, the wife of LaTour.

From Mount LaTour to Portage Brook the hills are high,* but none stand out distinctly until the brook is reached. Portage Brook occupies a deep and broad valley, with splendid hill ranges along both sides, and these are named the *Missionaries' Range* and the *Acadians' Range* to commemorate two peoples prominent in the history of the North Shore. One of the hills in the Missionaries Range, the prominent one as seen from below the brook, in the angle between brook and river, is named for *LeClercq*, who, in 1691, published a most valuable book containing much information about the lower part of the river. It will be well in the future to apply the names of other missionaries to other summits of this range, and likewise to apply the names of prominent Acadians to the summits in the Acadian range.

Just below the South Branch, on the south side, are two prominent rounded hills (Figure 17) which may be named *Mount Halion* and *Mount Winemowet* for two Micmac chiefs mentioned by Cooney.

* From the river alone one is apt to be misled as to the character of these hills along the river. They appear like long ridges, and one imagines deep valleys and other ridges behind them. In fact they are often but the edges of a great plateau, into which the river has cut a deep valley. It is only to more or less isolated mountains and ridges that names are applied in this paper.

Lower, on the north bank stands out a very prominent mountain (Fig. 17), which is named *Mount Membertou* in honor of the grand old Micmac sachem, friend of the French, and one of those who saw Cartier on the North Shore in 1534. Descending the river one presently sees a bare reddish summit appearing over a wooded ridge, the first glimpse of Fronsac (Fig. 17), and later there comes into view

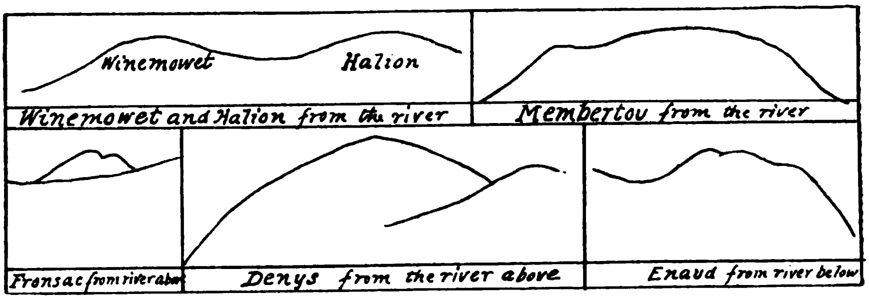


FIG. 17.

the symmetrical mountain locally called Bald Mountain (Fig. 17), but much better to be known as *Mount Denys* in honor of the first settler at the mouth of the river, and the author of one of the most important early works on Acadia, published in Paris in 1672. North of it lies *Mount Fronsac* (Fig. 18), somewhat higher than Denys itself, but otherwise less distinctive, named for the Sieur de Fronsac, Denys' son, who lived and had a fort at Miramichi. Southwest of Denys there

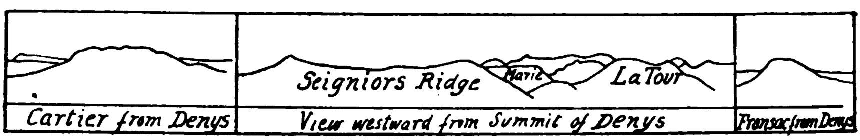


FIG. 18.

towers up a bare mountain visible from many points (Fig. 18), the highest and most conspicuous in this vicinity (sometimes, I believe, called Little Bald Mountain), which may well be named *Mount Cartier* in honor of the first explorer and map-maker of our North Shore. To the westward rises a high and prominent ridge, which is named the *Seigniors Ridge* for the French Seigniors who once possessed much of New Brunswick, and played some small part in her history. To the eastward is a lower mountain, which shows more prominently from

the river below (Fig 17), and this is named *Mount Enaud* (also spelled Enault) for one of the most prominent of the early settlers at the mouth of the river, mentioned by Cooney.

Below Indian Falls no more prominent mountains appear. The country becomes a flat plateau, sloping evenly and gradually eastward.

31.— On Heights determined with Aneroid in 1899.

(Read December 5th, 1899).

In the course of a canoe trip up the Tobique and down the Nepisiguit in August last, I made many measurements with a good aneroid. These were all taken contemporaneously with the readings made at Fredericton by Dr. Harrison for the meteorological service, and I wish to express my thanks to him both for adjusting my aneroid and also for a long series of readings used in computing results. I have since found that my aneroid tends to read a trifle low, especially on the greater heights; hence the following figures are to be taken as below, rather than above, the truth. Those marked with a star (*) have never before been measured. The heights are all above mean sea level at St. John. The position of all of the places, except the last in the list, may be seen upon the map accompanying Note 30.

Forks of Tobique (or Nictau). Mean of two measurements, 576 feet. Wightman gives (with an added correction explained earlier in Note 25) 575 feet for four miles below Nictau.

Surface of Nictor Lake. Mean of fourteen measurements, 837 feet. Chalmers made it 878, and Wightman (corrected) 877. Mean of the three, 864.

Sagamook (or Bald) Mountain. Mean of two measurements, 1633 feet above the lake. Chalmers gives 1659, and Wightman 1719. Mean of the three, 1670 above the lake, and 2534 above the sea.

*Mount Carleton. By direct measurement 112 feet higher than Sagamook, and hence 1782 above Nictor Lake, and 2646 above the sea.

*Mount Gordon, on Nictor Lake. 705 feet above Nictor Lake, and 1569 above the sea.

*Bank of Caribou Brook, half way across the Nictor-Nepisiguit Portage, 984 feet.

Surface of Nepisiguit Lake. Mean of five measurements, 1011 feet. Chalmers gives 996; mean of the two, 1003. Mr. Chalmers statement that this is the highest lake in New Brunswick, was of course made before the heights of the lakes on the south branch of Tobique, which are much higher, were measured. By direct measurement I made it 145 feet above Nictor Lake, *i. e.*, 864 + 145 = 1009.

*Mount Teneriffe. By direct measurement, 1105 feet above Nepisiguit Lake, and hence 2108 feet above the sea. Mr. Chalmers is in error in stating that this is about as high as Sagamook. Even as seen from Sagamook it is much lower.

*Mount LaTour. By direct measurement, 1150 feet above the river. As this falls 160 feet between the lake and Portage Brook, and the fall is considerably greater below than above it, the river is here probably 940 feet above the sea, and hence LaTour is 2090 feet above the sea.

*Mouth of Portage Brook, river level. Mean of five observations, 843 feet.

*River at camping place near the "bear house" at foot of Mount Cartier or Bald Mountain. Mean of four observations, 715 feet.

Mount Denys, or Bald Mountain, above Indian Falls. By direct measurement, above the river at the camping place, 1175 feet. In 1898 I made it 1170 feet; mean, 1172. This agrees well with the height of 1183 feet on the survey map of 1832 by Peters. Mean of these two, 1138, which, added to the river level, gives 1893 feet above the sea. Chalmers, following Ells, gives 1922; mean, 1907. There are higher mountains in the near neighborhood.

Mount Enaud, or Bald Face Mountain, is given on the Peters map as 998 feet high, that is, of course, above the river, and hence about 1690 feet above the sea.

*Lower end Indian Falls. Mean of three measurements, 632 feet.

*Mouth of Nine-mile Brook. Mean of two measurements, 429 feet.

APPENDIX.

THE FREDERICTON NATURAL HISTORY SOCIETY.

(Instituted February 2nd, 1895).

The Society continues to hold its meetings in the High School Building through the kindness of the School Board. The attendance has been generally good, and much interest shown in the discussion of the subjects dealt with in the papers read before the Society.

During the year addresses were given, or papers read, as follows:

1899.

Feb. 20.	Insect Life, by Mr. Wm. McIntosh.
Mar. 20.	Electricity, by H. H. Hagerman, M.A.
April 17.	A Talk on Insects, by Mr. G. W. Bailey.
May 15.	The Eye, by Dr. Bailey.
Oct. 16.	Our Summer's Work, by Dr. Bailey and Mr. W. T. L. Reed.
Nov. 20.	How the Brain Works, by Mr. John Brittain.

At the May meeting Mr. W. H. Moore presented the Society with a number of alcoholic specimens of Reptilia and Amphibia; Mr. Drury Allen donated a collection of birds' eggs, and Mr. H. H. Hagerman, a crayfish and a cat-fish.

The officers of the Society for the year ending in February, 1900, are:

L. W. Bailey, Ph.D.	*President.*
G. N. Babbitt, Esq.	*Vice-President.*
John Brittain	*Secretary.*
B. C. Foster, M.A.	*Treasurer.*
H. H. Hagerman, M.A.	*Curator.*

JOHN BRITTAIN,

Secretary.

KINGS COUNTY NATURAL HISTORY SOCIETY.

(Organized at Sussex, Kings County, N. B., October 2nd, 1897).

The officers for the year ending October 2nd, 1899, are as follows:

R. P. Steeves, A.M. ....*President.*
Miss L. Wetmore.......................*Vice-President.*
W. N. Biggar..........................*Secretary-Treasurer.*

During the year nine meetings were held, eight regular and one special. The following papers have been read before the Society:

1898.		
Nov.	5.	Snakes, by Miss Annie White.
1899.		
Mar.	4.	The Deer Family, by Miss Annie White.
		Fur-bearing Animals, by W. A. Alward, A.B.
April	8.	Insects Injurious to House Plants, by W. E. Goold.
		Unity of Living Things, by Robert King, A.B.
		Return of Birds, by Miss L. Wetmore.
May	5.	Moths and their Preventatives, by Miss Edith Darling.
		A Spring Ramble, by Miss L. Wetmore.
		The Nuthatches, by Miss L. Wetmore.

The result of the work of collecting for the museum has been the addition of forty-four specimens to the scientific collections.

For the better keeping and exhibiting of the specimens, the Society has procured this year the following: one large cabinet for minerals, etc., one glass case for birds, and two cases for insects.

Eight new members were added to the roll during the year.

The thanks of the Society are due the Natural History Society of New Brunswick for Bulletins, etc., received., and also to Mr. G. U. Hay for assistance rendered.

W. N. BIGGAR,
Secretary.

THE NATURAL HISTORY AND ANTIQUARIAN SOCIETY OF PRINCE EDWARD ISLAND.

(Instituted March 28th, 1889; re-organized January 16th, 1899).

During 1899 eleven public meetings have been held, and on each occasion the attendance has been good.

The dates of the meetings and the subjects of the papers and lectures were as follows:

1899.		
Jan.	10.	Re-organization.
	24.	Business meeting, followed by an impromptu address upon "Some of our Fungi," by Mr. John MacSwain.
Feb.	7.	Rust of Wheat, by John MacSwain.
	21.	Geological Reminiscences of Prince Edward Island, by Thos. May.
Mar.	7.	Floriculture, by James Tait.
	21.	An Abnormal Vegetable Growth in the Human Throat, by L. W. Watson, M.A.
Apr.	4.	Some Geological Evidences of the Nebular Hypothesis, by John Newson.
	18.	Some Effects of Solar Radiation upon Organic Life, by W. J. Bulman, B.S., etc.
May	2.	Some Notes on Man Primeval, by Charles Palmer, Q.C.
	16.	The Colored Races of P. E. Island, by J. T. Mellish, M.A.
Nov.	27.	*(a)* Notes on Fungi Collected by Miss Pippy, 1899, by John MacSwain
		(b) Note on a Piece of Petrified Wood found in the heart of a living Tree, by J. M. Duncan.
		(c) Explanation of an Abnormal Potato Growth (exhibited by Mr. W. Doull), Lawrence Watson.
Dec.	11.	An Introduction to the Study of Mineralogy, by Rev. T. H. Hunt, M. A., B. D.

The annual "outing" was held on the 24th of June, when the Society and many guests, having visited on the way the Micmac encampment at Rocky Point, walked to the ruins of "Ringwood," where Hon. F. St. Croix Brecken delivered a short address upon the Life and Times of Col. Cumberland. The ruins of Fort La Joie were next visited, where Messrs. Brecken and Newson delivered very inter-

esting addresses upon the history of the place. The position of many historic sites was pointed out by Mr. Newson as the party, after luncheon at the President's summer residence, proceeded on its way to Holland Cove. Here the listeners enjoyed the reading by Mr. Brecken of a paper upon Captain Holland and his work, embodying much matter of rare historical value.

During the year a delegation from the Executive Committee interviewed the Provincial Government, praying for a grant of money (such as is annually given our sister societies in the other provinces), and the use of rooms for the Society and for museum accommodation. The delegation was most kindly received, and the accommodation asked for was promised as soon as any suitable rooms at the disposal of the government should become available.

Application was made to the Geological Survey for a collection of mineralogical specimens which has been promised so soon as our Society shall have a suitable place in which to store and exhibit the grant.

We have received the publications of a few sister societies, and it is much to be desired that we may soon be in financial position to publish such bulletins as will enable us to secure a number of similar "exchanges," the educational value of which cannot be over-estimated.

In conclusion, it is gratifying to recognize on every hand, many evidences that the Society enjoys the confidence, interest and good-will of the community at large, that it is conceded that material advance has been made in the educational work of the Society, and that the prospects of rapid growth and constantly-increasing usefulness are of the very brightest character.

LAWRENCE W. WATSON,
Secretary-Treasurer.

Charlottetown, P. E. I.

THE ST. JOHN OBSERVATORY.

In addition to the annual meteorological abstract, a brief description of the instruments and work of the St. John Observatory may be of interest.

The Observatory is the chief station in New Brunswick under the Canadian Meteorological Service of the Department of Marine and Fisheries.

Observations of pressure, temperature, hygrometric conditions of the air, amount and character of precipitation, clouds, velocity and direction of the wind and general conditions of the weather are made at intervals of four hours, commencing at 3.44 A.M. local time. In addition to the meteorological work, astronomical observations are made for determination of time.

The Director's office, instrument and clock room is situated in the north wing of the Customs building, the thermometer shed and rain gauge on the ground adjoining the observer's residence, the anemometer and wind vane are mounted on the time ball tower.

The standard barometer by H. J. Green, New York, is constructed on Fortin's principle, the level of the mercury in the cistern being adjusted previous to each reading; secondary to this is a smaller barometer of the same construction, and a Richard's barograph (self-recording barometer). The thermometers are all by Negretti & Zambra of London, have been tested at the Kew Observatory in London, and are exposed in the Canadian pattern shed and screen which faces north, the bulbs of the principal thermometers being four feet above the soil. The highest and lowest temperatures are registered by mercurial maximum and spirit minimum self-registering thermometers which are read and re-set at the midnight observation, the temperature of the air at time of observation from the ordinary mercurial thermometer, and the hygrometric observations from a pair of thermometers, one of which has its bulb covered by a thin muslin wrapping, kept moistened by water or covered by a thin coating of ice during freezing weather.

The anemometer is of the Robinson pattern, and with the wind vane records electrically the direction and velocity of the wind upon the register. The register has three essential parts,—the cylinder, the clock and the electro magnets. A specially ruled sheet is placed upon the cylinder and revolved by means of clock work; the direction of the wind is printed upon the sheet every five minutes, and a mark is made at right angles to the direction of the revolution of the cylinder for each mile of wind, and the number of marks within a given space shows the rate per hour at which the wind is blowing. The sheet placed on the cylinder holds the record for twenty-four hours.

The rain gauge has a circular receiving surface equal to ten square inches. No snow gauge is used, but it is assumed that ten inches of snow equals one inch of rain.

The astronomical equipment is intended specially for the determination of correct time. The transit room is situated on the western side of the building, and the transit telescope is mounted on a substantial brick pier, capped with stone. It is of modern construction by Troughton & Simms, London, has an object glass of two and a half inches diameter, two setting circles attached to the tube, micrometer eye pieces and electric illumination. Observations of stars on the meridian are made with this instrument for the correction of clock errors and rates.

The standard sidereal clock by Victor Kullberg, London, was received at the Observatory in September, 1899. It has a zinc and steel compensated pendulum, similar to the standard sidereal clock of the Royal Observatory, Greenwich, a central steel rod being surrounded to about the middle of its length by a tube of zinc, and then incased by an outer tube of steel. The latter carries the lead bob, which is cylindrical in shape (weighing forty pounds) and suspended at the middle of its height, thus eliminating the temperature changes in the bob itself. This clock is of the best construction, and is fitted with break circuit attachment for operating chronograph. The movement and pendulum are mounted on a solid iron bracket, which is firmly bolted to heavy masonry; the iron base and bracket also carries the case of solid teak. To prevent sudden changes of temperature from affecting the clock, it is enclosed in a closet which is thickly padded with felt.

The transmitting clock, which was formerly used as a standard sidereal, was made by Emanuel, of London. It has lately been fitted with electric contacts for automatically transmitting time by the electric telegraph. It has a mercurial compensated pendulum, and is enclosed in a similar closet to the one described for the sidereal standard. There is also another mean time clock, with mercurial pendulum and a box chronometer, in the observatory.

The time ball on the northern tower of the Customs building is dropped by an electric key on the table which contains the electric telegraph instruments.

D. L. HUTCHINSON,
Director.

METEOROLOGICAL ABSTRACT FOR 1899.

OBSERVATIONS RECORDED AT ST. JOHN OBSERVATORY, LATITUDE, 45° 17′ N.; LONGITUDE, 66° 4′ W.

D. L. HUTCHINSON, *Director*.

	Barometer.			Temperature.			Cloudiness: 0 = clear; 10 = wholly clouded.	Precipitation: Rain and melted snow.	Wind Direction and Velocity. N.		N.E.		E.		S.E.		S.		S.W.		W.		N.W.				Thunder Storms.
	Mean.	Highest.	Lowest.	Mean.	Maximum.	Minimum.			Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours Calm.	Total Miles.	
January	30.30	30.75	29.08	19.9	46	−12.7	5	4.35	28	312	91	1096	17	194	44	843	21	858	128	1954	55	814	339	5724	21	11,295	0
February	29.83	30.51	29.13	18.7	43.7	−7	6	3.14	24	199	108	1876	29	299	24	331	13	78	55	771	76	1170	329	5852	19	10,079	0
March	29.95	30.62	28.76	27.2	45.5	2.8	7	5.48	41	361	194	1924	25	196	79	1247	36	356	124	2313	29	484	187	3314	29	10,195	1
April	30.01	30.33	29.48	39.01	61.7	22.5	6	0.94	67	880	132	1408	28	813	61	514	122	801	78	1041	28	224	154	2015	50	7,196	0
May	30.03	30.31	29.61	48.3	79.2	30.5	6	3.51	29	423	213	2652	22	189	63	337	160	1124	96	1007	6	74	84	1177	71	6,933	0
June	29.97	30.36	29.66	54.5	80.2	44 8	7	2.65	42	346	103	1035	16	84	67	352	187	1363	129	1561	14	127	114	1435	48	6,303	4
July	29.95	30.30	29.60	59.1	78.5	46.2	7	7.47	20	103	24	159	12	88	144	949	218	1280	135	1468	35	306	68	786	88	5,139	4
August	30.02	30.40	29.74	62.5	79	47.7	6	2.17	20	137	66	449	33	309	84	546	163	900	120	1080	9	53	147	1546	102	5,020	1
September	30.06	30.49	29.57	55.4	70.2	34	4	3.05	24	157	60	481	43	344	122	961	101	740	187	2219	20	223	148	2254	15	7,382	1
October	30.20	30.54	29.65	47.7	70	29	6	2.49	78	641	97	852	23	126	44	382	61	347	149	2026	18	154	246	2778	29	7,806	0
November	30.02	30.56	29.42	34.7	59.7	16.2	6	3.37	107	1192	91	988	1	1	31	464	14	239	108	1151	74	491	277	3648	17	8,164	0
December	30.04	30.83	29.31	27.7	51.8	−2.5	6	5.45	113	1083	110	1052	46	416	48	1183	21	290	127	2389	55	611	216	3130	8	10,304	0

Barometer readings have been reduced to sea level and 32° Fahrenheit. The minus sign when used indicates temperatures below zero. The maximum temperature, 80.2, was registered on the 9th of June; the minimum, − 12.7, on the 2nd January. The total precipitation for year was 44.07 inches.

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ARTICLE I.

NEW SPECIES OF CAMBRIAN FOSSILS FROM CAPE BRETON.

By G. F. Matthew, LL. D., F. R. S. C.

(Read October 2, 1900.)

While engaged in the study of the Cambrian formation of Cape Breton, and in collecting fossils from this terrane in the summer of 1899, the writer met with some new species; these are of interest to the biologist as showing mutations of forms described from other areas, or as carrying previously known genera to lower horizons.

The Director of the Canadian Geological Survey, Dr. G M. Dawson, C. M. G., has kindly allowed the writer to publish these species in advance of a report on the work in Cape Breton.

The lower and middle zones of the Cambrian in Cape Breton are comparatively barren of fossils, and the species herein described are chiefly from the upper zones. They consist of Brachiopods of the orders Atremata and Protremata, with some few Trilobites. Other fossils were collected, but as they are of species already described, they are not included in this article.

Though the fossils herein described are referred to the three several zones of Parabolina, Peltura and Dictyonema, all in the Bretonian Division of the Cambrian, there is some uncertainty as to the references of the species *Lingula lens*, n. sp., to the Parabolina Zone. The exposures are very limited where this fossil occurs, and its position is fixed by the occurrence of a Peltura limestone band a little way above it. The fossil occurs in beds which are strongly ripple-marked, filled with worm burrows, and bear other marks of shallow-water deposition. Further observations, however, may show that these ripple-marked beds are within the Peltura Zone.

The band above, of the Peltura Zone (3 *b*), containing the three species of trilobites herein described, does not accord closely in its species with the strata of the same zone as known at St. John, but

the Dictyonema Zone on McLeod Brook, by its fossils, show a close affiliation with the zone 3 *c* at St. John, many species being identical with those of Cape Breton.

The zones of the Cambrian terrane where the fossils described in this article were found are the following: *

	Bretonian Division.		
	Parabolina Zone.	Peltura Zone.	Dictyonema Zone.
Linguella (?) Escasoni	... .	×	....
Lingulella concinna	....	....	×
Lingula (?) lens	×	... .	....
Acrotreta bisecta	... .	....	×
Schizambon priscus	....	....	×
Agnostus trisectus, mut. ponepunctus	....	×	.... ..
Agnostus trisectus, mut. germanus	....	×	....
Sphærophthalmus Fletcheri	....	×	....
Parabolina Dawsoni	....	×	....

DESCRIPTION OF THE SPECIES.

Lingulella (?) Escasoni, n. sp. Pl. V., figs. 1*a*–*i*.

Corneous, but having a thin outer calcareous layer. The inside of the edges of the valves is flattened.

Ventral valve ovate, pointed at the apex, somewhat elevated from the umbo, along the axial line. *Interior.*—Cardinal area short, traversed by a depressed pedicle groove. The cavity within the umbo has impressions of two small, cardinal muscles, from which radiate two grooves, bordered outside by ridges that separate the lateral muscle scars from the visceral cavity. The print of the central muscle is oval or lenticular and transverse to the axis of the valve; it is divided lengthwise, half way, by a septum; the posterior half of the scar is again divided by a faint ridge at right angles to the septum named. The "l" laterals are small triangular imprints in front of the outer part of the central muscles. In some valves the paired scars of the "k" laterals at the middle of the central group are small, and behind them extending toward the umbo is a sharp furrow enclosed between narrow ridges; in others they are wider and the ridges are not preserved. The grooves of the lateral muscles are discernable near the hinge on each side; the transmedian ("i") being external and on the

* A table at the end of this article shows the relation of these zones to the Cambrian succession as a whole.

inner edge of the flattened margin of the valve; the "j" laterals are on the slope of the valve within the flattened margin.

The vascular trunks extend forward in a regular arch from the middle of the valve a little within the flattened margin, which is creased transversely by about a score of closely set parallel grooves. In the anterior third these give place to grooves that are at right angles to the margin; these correspond in course to the faintly impressed sub-parallel grooves that extend from the front margin across the middle of the valve to the visceral callus. Faint traces of branches of the vascular trunks are seen on the slopes of the valves in the anterior half.

The *dorsal valve* is of an oval form. It is strongly arched down in the posterior half, but less so on the anterior slopes. *Interior.*—This shows at the cardinal lines a depression in which are a pair of circular pits, due to the cardinal muscles. Between these pits, on the axial line is a small pit from which two sharp low ridges run forward; at one-third from the back of the valve there is a minute scar between these ridges; and outside of them in the posterior half of the valve are the large oval prints of the central ("h") muscles; these are set somewhat diagonally to the axial line, having the fronts turned outward. At the anterior ends of the median ridges are the small scars of the anterior lateral ("j") muscles. Faint diverging ridges extend from the umbonal cavity toward the lateral margins of the valves; at one-third from the back, partly on and partly outside the ridges are the large but rather faint imprints of the posterior lateral muscles.

This valve, like the ventral, has flattened margins on which are imprinted minute, closely set, transverse grooves.

Sculpture.—The sculpture of the true outer surface of this species is not easily found; it is imprinted on a thin calcareous, fibrous layer, which is usually broken away, revealing the next layer of the shell. The outer layer is traversed transversely by closely set striæ, forming ridges of which there are about nine or ten in the space of a millimetre; some of these ridges have cross striæ at intervals, others anastomose, and all have a roughened surface; the ridges have a waving course over the middle third of the shell, but elsewhere are comparatively straight.

Beneath the outer shell is a corneous layer whose sculpturing conforms to that of the outer layer, but the striæ are wider and the inter-

vening ridges narrowed; this layer has a shining surface. Beneath this is a third layer on which the striæ run in an opposite direction from those of the one above, the sculpturing, especially along the central part of the valve, consisting of striæ radiating from the umbonal region to the front margin; these are crossed at intervals by undulations of growth concentric to the umbo; on the inside of this layer are impressed the surface markings of the interior of the valves.

Size.—Length, 5 to 5½ mm.; breadth, 4 to 5 mm.; depth of each valve, about 1 mm. The ventral is about ½ mm. longer than the dorsal. One dorsal has a length of 6 mm.

Horizon and locality.—In calcareous sandy layers with the Peltura fauna at McAdam shore, Escasonie, Cape Breton. This species was not found *in situ*, but in loose pieces of thin flag in the shingle of the shore where the trilobites occur; these pieces were very little worn, and therefore near or at the parent ledge. This species may be referred to the Peltura zone (3*b*).

This species is referred doubtfully to Lingulella as it has some characters of other genera. The weak cardinal development is like Leptobolus; as is the long lateral ridges and advanced ("j") laterals of dorsal valve. The spreading vascular trunks of the ventral valve are like Leptobolus and Obolus, as also the advanced "j" lateral. On the other hand the thick shell is quite unlike Leptobolus, but common in Obolus and Lingulella.

This pretty little species is easily recognized by its peculiar transverse sculpture. *Lingula teneola*, Hall, has a similar transverse ornamentation, but it is much larger, and flourished at a later period (Clinton group).†

Lingulella Ella, H. and W., has a somewhat similar sculpture, but is distinguished by its greater size, and the closer approximation of the vascular trunks of the ventral valve.

It is only in a few valves out of many that we find distinct muscle scars, enabling us to compare the species with others. Michwitz has determined that the exterior half of the great central muscle in the ventral valve of Obolus represents the "l" lateral of Lingula.* In this relation it is interesting to observe that the great muscle in *L. (?) Escasoni* also has a septum partly dividing it; but there is a separate scar, a small triangular one, at the anterior outer angle of

* Mem. Acad. Imp. des Sci. St. Petersbourg. Series VIII. Tom. IV., No. 2, p. 79.

† N. York State Geologists' Report. Hall & Clarke, 1891, pl. 1, fig. 8.

the great muscle, which with more probability may be considered the external lateral or "l" muscle; the large oval muscle would then be the "h" central (with possibly the "k" lateral involved), but it would consist of three main strands; for beside the septum across the middle at the back, the scar is divided by a more obscure transverse ridge parallel to the long diameter of the scar. This muscle then may be compared to those of Lingula, etc., having divisional lines.*

In *O. (L.) cœlatus*, Volb., we see an arrangement of muscle scars in the central group of the ventral valves similar to that in *L. (?) Escasoni* † Here Mr. Walcott interprets the small scar as an external lateral ("l"), but the larger one as a middle lateral ("k"). Volbooth's figure of this species does not show the small scar, but he appears to allude to it in the text where he says that "the several laterals of the ventral valve are not so closely bound together as in the subgenus Euobolus." ‡

LINGULELLA CONCINNA, n. sp. Pl. V, fig. 2*a–b*.

Occurring in the dark gray shales of the Upper Cambrian on McLeod Brook are a few examples of a small Lingulella smoother than a species from the same beds referred provisionally to *L. lepis*, but ornamented, as that species is by concentric ridges.

The shell substance is quite thin towards the lateral and front margins, and is then flattened out by pressure. The beak is somewhat blunt, and the rounded lateral margins give the ventral valve an ovate form.

Sculpture.—Over the visceral space the surface of the valves is covered with very fine concentric somewhat lamellose ridges, visible with a lense; over the branchial area these ridges flatten down, and the valve has a shining granular surface; the ridges, however, remain distinct on the lateral margins, though there also the surface is bright.

Size.—Length of the ventral valve, 8 mm.; width, 6 mm. The dorsal valve is nearly 1 mm. shorter than the ventral.

Horizon and locality.—In the fine dark grey shales of Div. 3*c*, at McLeod Brook, Boisdale, N. B. Scarce.

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*Introduction to study of Brachiopoda, Hall & Clarke. p. 229; fig. 23, and pl. 2, fig. 5.

† U. S. Nat. Mus. Proc. Vol. XXI., p. 385, Pl. xxvi., fig. 1.

‡ Imp. Acad. des. Sci., St Petersbourg. Ser. VIII., Tom. iv., No. 2. Pl. II., figs. 19*c* and 2*c*

This species is like *L. bellus*, Walcott, in form, but is smaller; also the growth lines are finer and more sharply defined on the surface of the shell. It is proportionately a wider species than *L. Billingsiana*, Whiteaves.

LINGULA (?) LENS, n. sp. Pl. V, figs. 3*a–h*.

Shell substance calcareo-corneous. A broadly ovate species, with rather thin, smooth valves, having flattened lateral slopes in the ventral valve, and being somewhat tumid toward the umbo in the dorsal valve.

Ventral valves rather blunt at the umbo, whence for about one-third of its length the curve of the margin is somewhat straightened, for the rest of the border it is regularly rounded to the front; the greatest width is a little in front of the mid-length. The umbonal ridge extends about half of the length of the valve, whence to the hinge the sides of the valve are flattened; in front of the middle of the valve the slopes are evenly but flatly arched down to the margin. *Interior.*—The position of the central group of muscles is within the posterior third of the valve, and the position of the laterals is indicated by a bounding ridge; these features are very faintly marked.

The *dorsal valve* is broadly ovate, and its slopes are more strongly arched in the posterior half than elsewhere, otherwise it is like the ventral. *Interior.*—This has a sharp, low septem for half its length, and on each side a parallel ridge, extending to the middle of the valve; at half the length of these ridges are small lenticular scars, and at their outer ends the group of central muscles. The lateral muscles form a wide arch at the sides of the valves, opposite the middle of the median ridges.

Sculpture.—The outer (calcareous) crust in this species is normally smooth in appearance, but is beset with minute pits. The sculpturing of the layer beneath has impressed itself on the outer layer in different parts of the surface; at the sides and in front we find concentric ridges, and in the middle third the imprint of the vascular striæ that run toward the front margin. These markings are much more distinctly shown on the next (corneous) layer.

Size.—Length of the ventral valve, 15 mm.; width, 13 mm. The dorsal valve is 1 mm. shorter than the ventral.

Horizon and locality.—Thin calcareous layers in the flags of Div. 3*a* at McAdam shore, Escasonie, Cape Breton. The shells in these

layers are freely intermingled with small lumps and particles of calcium phosphate. The phosphate lumps are frequently moulded on the shells, or entirely enclose them; though some shells are enclosed in the phosphate, others are free, and with fragmentary shells are mingled with the sand. Other masses of the phosphate are entirely free of the shells, and are smooth and shining, as though rolled on the beach; yet the flat, oval, or rod-like pieces of the phosphate seem the natural form which the substance assumed when in a gelatinous condition. Probably the formation of the phosphate was co-temporary with the entombment of the shells.

It seems doubtful if this species was at all near the recent Lingula in structure, yet it appears to be no nearer to Lingulella or Obolus; it is therefore left provisionally in the first named genus.

In its outline it is like *L. Covingtonensis*, H. & W., of the Lorraine Shales of Ohio.*

ACROTRETA BISECTA, n. sp. Pl. V, figs. 5*a–g*.

Shell substance thin, calcareo-corneous. Outline of the valves, oblately circular.

Ventral valve elevated conical. Height about one-quarter less than the width. The umbo is about a quarter of the length of the valve from the posterior margin. The valve is somewhat flattened on the posterior slope at the cardinal area, which is nearly as long as half the width of the valve, and has a deltidial area, bounded by distinct furrows; elsewhere the valve slopes regularly to the margin. *Interior.*—The mould is always truncated and has a somewhat convex summit; in some examples there are traces of one or two diaphragms extending across or over this part of the valve, from the anterior slope. A crescent-like ridge extends around the back of the summit of the mould and down the lateral slopes. Towards the front of the valve a pair of low ridges radiate toward the front of the mould, but fade out at one-quarter from the anterior margin.

The *dorsal valve* is most convex at the back, where the slope is nearly vertical; it has a long flattened slope to the front. *Interior.*—The mould of this species is marked by a long, deep, narrow furrow (indicating a strong mesian ridge); this is somewhat broader in the anterior third than elsewhere; the mould also has two pairs of pits

* N. York State Geologist's Report, 1891, Hall & Clarke, pl. 1, fig 7.

near this furrow, which perhaps indicate the position of the central muscles; the posterior adductors are indicated by bosses on the mould near the cardinal line, and the lateral muscles by depressions near the ends of the cardinal area. Fine radiating vascular lines are visible in the front half of the valve on each side of the median ridge. In young valves this ridge is only two-thirds of the length of that in the adult valve, the anterior third being smooth.

Sculpture.—The surface is marked by minute concentric beaded ridges, visible only with a strong lens; there are stronger growth lines at intervals.

Size.—Length, 3 mm. Width, 3¼ mm. Height of the ventral valve, one-fifth to one-quarter less.

Horizon and locality.—The fine dark grey shales of the Dictyonema beds (C. 3*c*) at McLeod Brook, Cape Breton.

On re-examining the specimens from this horizon at Navy Island, St. John, N. B., which I had compared with *A. Baileyi*, of the Paradoxides beds, I find it is identical with the species from McLeod brook. It is distinguished from *A. Baileyi* by the long, sharp median ridge of the dorsal valve; the convex summit of the mould of the ventral valve also distinguishes it from that species, in which the summit is concave, and proportionately smaller.

From *A. socialis*, Von Seebeck,* this species is distinguished by its somewhat larger size, and by the absence of the sharp wedge-shaped furrow in the top of the mould of the ventral valve; also by the absence of the strong lateral furrows in the mould of the dorsal valve of that species; also by the deeper and longer mesian furrow of the dorsal valve of the McLeod brook species.

From *A. gemma*, Walcott,† this species is distinct by the convex top of the mould of the ventral valve, by the absence of an area to the dorsal valve, and the enlarged posterior end of the median ridge in this valve.

From *A. gemmula*‡ this species is distinct by its larger size, convex summit of the ventral mould; and by the smaller scars of the posterior adductors and sharper and longer median ridge of the dorsal valve.

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* Brachiopoda of the Paradoxides beds of Sweden. G. Linnarsson Stockholm, 1876, p. 16 pl. iii, figs. 32-35.

† U. S. Geol Surv. Bull., No. 30. p. 98, pl. viii, figs. 1*a*–*b*.

‡ Roy. Soc Can. Trans., vol xi, sec. iv, p. 87, pl xvi, fig. 2*a*–*d*.

SCHIZAMBON PRISCUS, n. sp. Pl. V., figs. 4*a–d*.

Shell substance firm, corneous (or calcareo-corneous ?). Outline orbicular, and valves lenticular and of moderate depth.

Ventral valve with a rounded umbo, the greatest depth in front of the umbo, about two-thirds from the front. About one-sixth or one-eighth from the posterior margin, the valve is perforated by an oval foramen, in front of which two narrow diverging ridges run forward to the front of the valve, where they are about as far apart as one-quarter of the length of the valve. There is considerable variation in the size and position of the foramen in the examples collected. *Interior.*—The foraminal passage is smaller within than at the outer surface of the shell, and is surrounded by a raised rim; from it two thread-like grooves run forward into the front of the umbonal cavity. (The ridges that run forward from the foramen on the outer surface of the shell are preserved as grooves on its inner surface.) The visceral callus, of a lenticular outline extends about half as far in front of the foramen as that is from the posterior margin; it is crossed by two faint diverging ridges on each side, and is bordered by two lateral stronger ridges, widely diverging, that mark the position of the lateral muscles; the length of these ridges is about one-third of that of the shell. Faint traces of vascular trunks are found in the lateral and posterior part of the shell and make a regular arch about one-sixth of the length of the shell, from its margin. The margin is flattened especially in the posterior half, toward the umbo.

The *dorsal valve* is flatter than the ventral, and its umbo somewhat removed from the posterior margin. The central part of the valve has a flattened triangular space extending back towards the umbo; as the lateral margins are flattened in the posterior half a low flattened ridge extends out on each side from the umbo to the mid-length of the valve. *Interior.*—This shows a broad flattened mesian ridge extending half way across the valve from the posterior margin, on each side of this about one-third from the back of the valve, and nearly that far apart, are obscure oval marks, probably indicating the position of the anterior adductor muscles. The margins of the valve are flattened behind. *Sculpture.*—This consists of sharply defined but very minute, concentric and radiating ridges that form a delicate cancellated pattern; on the highest part of the shell the concentric ridges are most distinct,

on the front part, the radiating ridges. No cicatrix marking the advance of the foramen was observed, but a progressive change of this kind is probably indicated by the paired thread-like ridges behind the foramen on the interior of the ventral valve.

Size.—Length and width each 4 mm. Depth about ⅔ of a millimetre, that of the dorsal valve less.

Horizon and locality.—Fine dark grey shales of the Dictyonema beds (C. 3*c*) at McLeod Brook, Cape Breton.

This pretty little species is the smallest and oldest known of its genus. Mr. Walcott indicates for *S. typicalis* a calcareo-corneous shell, but while there may be an outer calcareous layer to *S. priscus*, it has not been detected.* From the former species which is Ordovician, it differs not only in its small size, but its orbicular form ; it differs also in having radiating as well as concentric striæ on the outer surface. It is much smaller than Dr. Ami's *S. canadensis* of the Utica shale

In one example of the ventral in this species the foramen is in the umbo, but in the others it is in front of it. The ring around the inside of the foraminal opening is never prolonged into a tube as in Siphonotreta.

In re-examining the material from this horizon at Navy Island, St. John, I find that this species is present there also, but the surface markings are not well preserved ; however the form and size of the shell, and the foraminal opening, show it to be the same species.

AGNOSTUS TRISECTUS, Salt, mut. PONEPUNCTUS, n. mut. Pl. V, figs. 8*a-c*.

This form grows to a larger size than the type as figured by Tullberg, and differs in several respects. The reticulation on the head shield does not show a net-work near the glabella, but detached irregular furrows; opposite the posterior half of the glabella the ornamentation is scarcely more than small, sparse, irregular pits. The posterior end of the glabella is wider than that of the European form, and there are lateral lobes on the front of the main lobe.

In the pygidium there are also differences; the sculpturing of the side-lobes is scarcely more than shallow, open pits, faintly visible, and there is a small tubercle at the end of the rachis, which overhangs the rachial furrow. Examples of the pygidium showing the inner surface have as many as nine paired pits along the inner furrow of posterio

* U. S. Geol. Surv., Monog. viii, p 70, pl. i, figs. 8, 8*a* to *c*.

lobe of the rachis, showing that that lobe is composed of numerous somites.

Size.—The shields of this mutation of *A. trisectus* attain a length of 8 mm.

Horizon and locality.—In bitumenous limestone bed at McAdam shore, Escasonie, Cape Breton. Band, *3b*, Cambrian.

A singular condition of preservation of the test of this species is the rarity of remains of the thorax. Among two dozen heads and three dozen tails of this species, only one joint of the thorax was observed.

Larval characters.—The reticulation or furrowing of the cheeks, which is so obvious a character of adult head-shields, becomes less and less pronounced in the small heads, and disappear in minute ones. Faint furrows are impressed at the sides of the main lobe of the glabella, opposite the median tubercle, showing a somite here to which this tubercle belongs; the examples are 1½ mm. long, in which this is apparent.

A pygidium ¾ mm. long shows a comparatively short rachis of two segments, of which the anterior is dominated by a low ridge-like tubercle; no true anterior lobe, such as is found in adult shields, can be detected at this stage. The posterior lobe, by faint tubercles at the sides, is shown to be composed of at least two somites, yet the trisected condition of the rachis is already apparent.

Mut. GERMANUS, n. mut.

This interesting form has many points of resemblance to *A. trisectus*, and is of nearly the same size, but yet is not trisected on the posterior lobe of the rachis of the pygidium. This form and mut. *ponepunctus* sometimes occur scattered over the same surface of rock, but more frequently are distributed on different surfaces. The smoothness of the slopes of the shields and the absence of trisection in the posterior lobe might lead one to think it a different species from mut. *ponepunctus* and from *A. trisectus*, type, but the tubercle at the end of the rachis of the pygidium, peculiar so far as the author knows to the Cape Breton forms, leads one to think they belong to one species.

Since writing the above I have received a letter from Prof. J. E Marr, of St. John's College, Cambridge, who has had the examples of *A. trisectus* in the Woodwardian Museum examined, and also those of

the Geological Museum in Jermyn street, London; on none of these is there any trace of a tubercle at the extremity of the mid-lobe of the pygidium. This indicates a closer relationship between the two Canadian forms than is borne by either of them to the type, though the apparent difference seems to be greater; it appears also to show that the American mutations arose independently from the Longifront phylum. The indication is similar to that given by the development of *Anomocare stenotoides* from the Olenoid phylum, *i. e.*, a tendency to the independent development of similar forms at particular stages in geological history.*

The differences from *A. trisectus-ponepunctus*, are the following: The head shield is more strongly arched, stiffer and smoother; the pygidium is *not* trisected on the posterior lobe of the rachis, though faint furrows may sometimes be traced on one side or the other. It differs from the European type of *trisectus*, in that the median lobe traverses the middle part of the two anterior segments, thus interrupting the dividing furrow between these segments, and it differs also in its smooth, stiff shields.

This mutation shows a considerable resemblance to *A. princeps*, Salt † But Salter is emphatic in stating that there are no marginal spines to his species (nevertheless two of his figures show such spines, perhaps these are two species included under *A. princeps*). The figure of Salter's species which comes nearest ours is 1*b* of plate 5, but in that the tubercle on the glabella is represented as elongated and resting on the middle of the main lobe, while in the Cape Breton form it belongs entirely to the anterior segment or somite of the main lobe.

SPHÆROPHTHALMUS FLETCHERI, n. sp. Pl. V, figs. 7*a*–*f*.

General outline of the *middle piece of the head shield*, square, with a large, nearly cylindrical, glabella, which in front overhangs the narrow marginal fold. The glabella has a width two-thirds of that of the glabella and occipital ring together. A strong furrow divides off the posterior third of the glabella. The occipital ring is narrower than this lobe of the glabella, and bears a tubercle at the middle.

The fixed cheek is much drawn in behind and then arches downward and outward to the posterior margin. The front of the cheek is tumid and traversed by an ocular fillet directed diagonally backward.

* See Trans Roy. Soc. Can., vol. iv, sec. iv. pp. 140–148.

† Mem. Geol. Surv. G. Britain, vol. iii, p. 488, pl. 4, figs. 2 and 11*a*, and pl. 5, figs. 1*a* and *b*.

To the *movable cheek* is attached the large globular eye, placed near the back of the cheek, the cheek is prolonged outward into a flat spine of abnormal size; this spine is not narrower in the front quarter than the cheek itself, and curves backward in a regular arch at first, but toward the extremity becomes nearly straight.

Of the two ribs which traverse it, one is an extension of the posterior marginal fold, and the other is a prolongation of the elevated middle part of the cheek. The flattened area on each side of the spine is a special expansion of the anterior and posterior marginal folds, and towards the tip of the spine, narrows more rapidly than the area occupied by the ribs; of the flat areas, the outer is hollowed on the upper side, and the inner one somewhat convex, especially toward the base of the spine.

A young *hypostome*, imperfect at the front, which may belong to this species, has a narrow, elevated obconical anterior lobe extending two-thirds of its length; and an encircling, more depressed posterior lobe, occupying the rest of the hypostome; both lobes are convex, and no border fold is visible.

The *pygidium* of this species is broadly triangular, and has a strong obconical rachis of three segments, the third nearly as long as the two anterior. These latter have each an obscure lobe at the sides. The side lobes are narrow triangles, with a tubercle at the anterior outer corner. There is a distinct but narrow border fold at the sides and posterior end of the pygidium.

Sculpture.—This is exceedingly minute and appears to consist of very fine granulations, with a smooth, shining surface on the front lobe of the glabella; this part of the glabella shows occasional scattered small tubercles.

Size.— Length of the middle piece of the head shield 3 mm. width, 5 mm. Length of the movable cheek, 3 mm.; width, exclusive of the genal spine, $2\frac{1}{2}$ mm. Width of the genal spine, $2\frac{1}{2}$ mm.; length, 25 mm. Length of the pygidium, $1\frac{1}{2}$ mm.; width, 2 mm. Length of a young hypostome, $1\frac{1}{2}$ mm.; width, 1 mm.

Locality and horizon.—Limestone bed in Div. 3*b* at McAdam's shore, Escasonie, C. Breton.

This form is distinguished from the mutation *Canadensis* of *S. alatus*, found in the upper Cambrian shales at St. John,* by its long,

* Roy. Soc. Can. Trans, vol. xi, sec. iv, p. 107, pl xvii, figs. 11*a* and *b* and 12*a* and *b*.

flat and very wide, falcate genal spine. It agrees nearly with a spine and free cheek figured by Linnarsson, but not referred to any species.* The cheek portion of *S. Fletcheri* is very small compared with the spine, which is stiffened by the two sharp ridges that run along the middle; these ridges occupy about a third of the width of the spine, the rest being flat.

The flatness and great width of the spine is one of the most obvious points in which this species differs from mut. *Canadensis* and from the type of *S. alatus*.

The pygidium of this species differs from that of the type of *S. alatus* as figured by Linnarsson in the possession of narrow side lobes (about as wide as the marginal fold); that author's figure gives no side lobes, the marginal fold being in contact with the rachis.†

For numbers this is the dominant species in the trilobite bed at McAdam shore, as will be seen by the following proportion of forms found on five square inches of surface of one of the layers.

Sphærophthalmus Fletcheri, ...	30 hds.	24 chks.	
Agnostus trisectus, chiefly the mut. ponepunctus,	9 "	1 pl.	6 pyg.
Ctenopyge pecten, ...	8 "	3 chks.	
Peltura scarabeoides, ...	1 "	4 pl.	1 pyg.
Parabolina Dawsoni, ...	1 "		

All the heads of Sphærophthalmus were not counted; several were so small that the generic characters were not well shown.

Parabolina Dawsoni, n. sp. Pl. V, figs. 6a–f.

The *middle piece* of the *head shield* is sub-trapezoidal in form, is strongly arched in front, where there is a narrow but prominent marginal fold, and has triangular projecting posterior angles. The glabella is cylindro-conical in outline, and is as broad as its length and half of the width of the occipital ring; it is as broad opposite the first furrow as at the occipital ring, and thence narrow more rapidly to the front, which is strongly arched; the front margin is correspondingly arched, and the intervening area of the fixed cheek is therefore of nearly even breadth around the front of the glabella; the width of this area on the median line is two-ninths of the length of the glabella. The glabella is marked by three pairs of furrows, nearly equi-

* Swedish Geol. Surv., Ser. C., No. 43, p. 26. Pl. 2, fig. 14.

† Sverig. Geolog, Undersokning, ser. c, No. 43, p. 7, tafl. 1, fig. 10.

distant, and having the inner extremities turned backward; the inner half of the posterior furrow is deeply indented, the middle furrow is more evenly impressed, and the anterior furrow is more distinct in the outer half, which is at the anterior corner of the glabella. The occipital ring is of nearly even breath, has a tubercle on the axial line, and has a triangular lobe at each end on the anterior side, due to a faint furrow that crosses the ring diagonally. The fixed cheek is triangular, and at the front of the eyelobe as wide only as two-thirds of the space between the glabellar furrows; the eyelobe is opposite the space between the second and third furrow of the glabella, and there is a short ocular fillet extending diagonally out to it from the anterior corner of the glabella. The posterior marginal furrow and fold are distinctly marked.

The *movable cheek* is more strongly arched in front than behind, and, like the middle piece of the headshield, has a sharp, narrow marginal fold; the area of the cheek is somewhat wider in front than behind, and the proportion in length of the three cords of the facial suture are 1, 1, 2½. There is a narrow, sharp genal spine, of unknown length, projecting backward from the outer angle of the cheek.

The *thorax* has narrow rings with narrow pleuræ, having sharp backward-curved points. The thoracic rings have triangular lobes at the outer ends and a median tubercle, like the occipital ring. The pleuræ have a sharp, oblique furrow, extending to the geniculation.

A *hypostome* supposed to belong to this species has a large, oval anterior lobe, narrower behind; an upturned margin borders it at the sides, but at the back is broken away.

The *pygidium* has two well marked rings to the rachis, each surmounted by a tubercle, and a posterior lobe which is obscurely divided into two somites. The side lobes have two faintly marked ribs with diagonal grooves, and the borders of the side lobes are flattened. A small backward, outward projecting spine is placed at the anterior corner, on each side.

Sculpture.—The area in front of the glabella is ornamented with forking and anastomosing raised lines, radiating toward the anterior margin. The glabella appears smooth, but under a strong lens is seen to be minutely punctate, or even obscurely reticulate with raised lines. The movable cheek, like the area in front of the glabella, is ornamented with distinct raised lines, giving a reticulate surface; toward the marginal fold these lines are forked and directed outwards

The reticulation of raised lines is more distinct on the interior than on the exterior surface of the test. A similar but faint reticulation is visible on the front half of the fixed cheek. The surface of the glabella, seeming smooth, when viewed with a lens appears to be faintly marked with scattered pits or depressions. The front and lateral marginal fold of the head-shield, when viewed with a strong lens, is seen to be minutely striate lengthwise of the fold.

Size.—The head-shield figured is not the full size of this species, for some pleuræ shows that it grows to a size one-quarter longer.

This species is closely allied to *P. acanthura*, Ang.,* from which it differs in the following respects: The area in front of the glabella is wider and more strongly arched, and the fixed cheek is more pointed at the posterior outer angle. In the free cheek the rim is more strongly arched in front, and has less width behind. The joints of the thorax have tubercles, or, in some cases, spines on the rings. The pygidium has a median tubercle on each of the first two joints, and the marginal spines of which only one pair is known, are directed outward rather than backward. In other respects the two species, in so far as comparisons can be made with the imperfect material obtained, are much alike.

This species is distinguished from *Protopeltura acanthura*, var. *tetracanthura*,† by the broad area in front of the glabella, and by its broader pygidium with fewer joints. From *Parabolina heres*, var. *lata*,‡ it differs in the arched anterior border fold, and narrow fixed cheek. From *P. heres*, as depicted by Brogger, it differs in its shorter pygidium of fewer joints †† From *P. acanthura*, as figured by the same author, in its more quadrate glabella, and in the tubercles on the rings of the rachis of the pygidium.‡‡ From *P. heres*, as shown by Moberg and Moller, in the absence of strong reticulation on the surface of the fixed cheek, and the fewer joints in the pygidium.§ From *P. acanthura*, as figured by these authors, in the arched front of the head-shield, and in the presence of tubercles on the rachis of the pygidium.||

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* Palæontol. Scand., p. 49, pl. xxvi, fig. 9. Also Om Acerocare, Moberg & Möller, Stockholm, 1898, p. 259, tafl. 12, figs 1a and 4a.

† Roy, Soc Can , Trans., vol. ix, sec. iv, p. 53, pl xiii, figs. 8a–c.

‡ Roy. Soc. Can . Trans., vol ix. p. 51. pl. xiii, figs 6a–f.

†† Di · Silurish. Etag. 2 und 3, p. 101, tab. i, fig. 18a.

‡‡ Idem, p. 106, tab. 14, 14c.

§ Om. Acerocarezonen, Stockholm, 1898, p. 267, tafl. 12, figs 8a, 11a.

|| Idem. p. 259, tafl 12 figs. 1a and 4a.

From *Parabolinalla Plantii*, Salter, as figured by F. R. C. Reed, it differs in its arched front margin, broader glabella, differing glabellar furrows, and in possessing pygidial spines.*

If it were not for the pair of marginal spines at the front corner of the pygidium, this species, from the flattened side lobes of the pygidium and other features, would fall under Brogger's sub-genus Parabolinella.†

The following scheme of the succession of faunas of the St. John group in New Brunswick, Canada (amended to include later discoveries), is quoted from Vol. VIII., Sec iv., p. 129 of the Transactions of the Royal Society of Canada, to show the relation of these Cape Breton species to the Cambrian succession as a whole.

ACADIAN DIVISION (1).

Band *a* Fossils unknown.
b Zone of the Protolenus Fauna.
c, *d*, *e* } Three sub-zones of the Paradoxides Fauna.

JOHANNIAN DIVISION (2).

Band *a* No trilobites or brachiopods known from this zone—trails and markings only.
b Zone of Lingulella Starri.
c Zone of L. radula.

This division holds the position of the Olenus Fauna of Europe.

BRETONIAN DIVISION (3).

Band *a* Zone of Parabolina spinulosa.
b " Peltura scarabeoides.
c " Dictyonema flabelliformis.
d " Tetragraptus.
e Zone with small brachiopods of doubtful range.

DESCRIPTION OF THE PLATE.

FIG. 1. *Lingulella (?) Escasoni*, n. sp. —*a* Ventral valve; —*b* Interior of same; —*c* Longitudinal section; —*d* Dorsal valve; - *e* Interior of same; —*f* Longitudinal section all mag. $\frac{6}{1}$; —*g* Group of central muscles of ventral, mag. $\frac{10}{1}$; viz., "h" the main laterals showing the print of three strands of the muscles, "l" the anterior laterals, "k"

* Geol. Mag. New Ser., Dec. iv, vol. vii, p. 303, fig. 1.
† Geol. Mag. London. New Ser. Dec. iv, vol. iii p. 303.

laterals ? v. the heart shaped (lozenge shaped) depression ; —*h* Enlargement of the outer surface, mag. $\frac{20}{1}$; —*i* Sculpture of the second layer of the shell, mag. $\frac{20}{1}$. All from Div. 3*b* Escasonie, Cape Breton, N. S.

FIG. 2. *Lingulella concinna*, n. sp. —*a* The ventral valve ; —*b* Interior of the same, mag. $\frac{3}{1}$. Div. 3*c* McLeod Brook, Boisdale (C. B.), N. S.

FIG. 3. *Lingula (?) lens*, n. sp. —*a* Ventral valve ; —*b* Interior of same ; —*c* Longitudinal section ; —*d* Dorsal valve ; —*e* Interior of same ; —*f* Longitudinal section ; all mag. $\frac{2}{1}$; —*g* Sculpture at the margin of the valve, mag. $\frac{6}{1}$; —*h* Surface at the middle of the valve, mag. $\frac{5}{1}$. All from Div. 3*a* Escasonie (C. B.), N. S.

FIG. 4. *Schizambon priscus*, n. sp. —*a* Interior of the ventral valve; —*b* Longitudinal section ; —*c* Interior of the dorsal valve; —*d* Longitudinal section ; all mag. $\frac{6}{1}$, and from Div. 3*c* McLeod Brook, Boisdale, (C. B.), N. S.

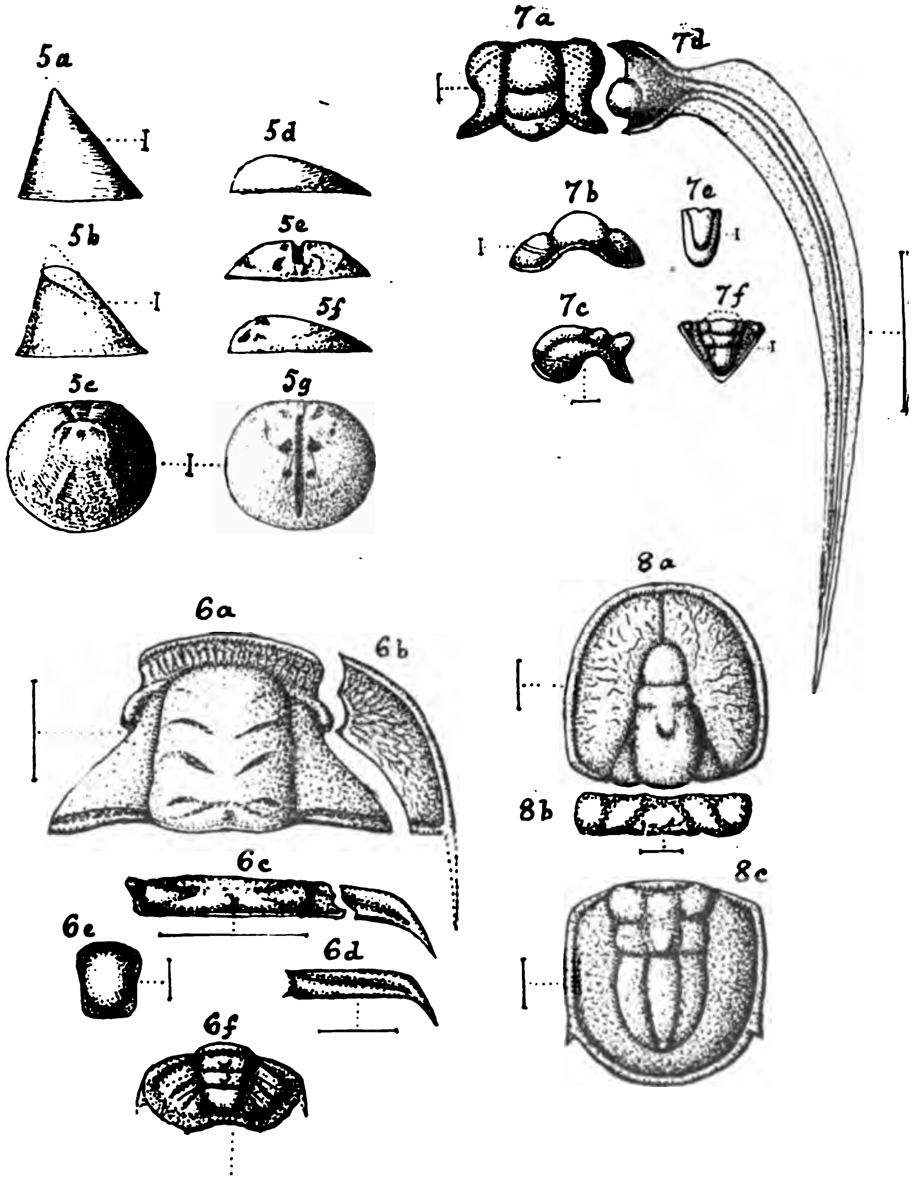
FIG. 5. *Acrotreta bisecta*, n. sp. —*a* Ventral valve, side view ; —*b* Mould of interior of this valve ; —*c* Mould seen from above; —*d* Dorsal valve; —*e* Mould of the interior of the same seen from behind ; —*f* Same seen from the side ; —*g* Same seen from above ; all mag. $\frac{6}{1}$, and from Div. 3*c* McLeod Brook, Boisdale, (C. B.), N. S.

FIG. 6. *Parabolina Dawsoni*, n. sp. —*a* Middle piece of the head-shield ; —*b* Movable cheek ; —*c* An anterior joint of the thorax ; —*d* A pleura from the middle of the thorax ; —*e* Hypostome of a young individual ; *f*—Pygidium ; all mag. $\frac{2}{1}$, and frem Div. 3*b* Escasonie, (C. B.), N. S.

FIG. 7. *Sphærophthalmus Fletcheri*, n. sp. —*a* Middle piece of the head-shield ; —*b* Same seen from the front ; —*c* Same seen from the side ; —*d* Movable cheek ; all mag. $\frac{4}{1}$; —*e* Hypostome ; —*f* Pygidium ; both mag. $\frac{6}{1}$. All from Div. 3*b* Escasonie, (C. B.), N. S.

FIG. 8. *Agnostus trisectus*, mut. *ponepunctus*. n. mut. —*a* Head-shield ; —*b* A joint of the thorax ; —*c* Pygidium ; all mag. $\frac{4}{1}$, and from Div. 3*b* Escasonie, (C. B.), N. S.

PLATE V.



ARTICLE II.

NOTES ON THE ARCHÆOLOGY OF NEW BRUNSWICK.

By Samuel W. Kain.

(Read December 4, 1900.)

These notes on the archæology of New Brunswick have been written for the information of the members of this society. Elsewhere much attention is being paid to this subject, and it behooves us not to lag too far behind our co-workers in other parts of Canada. I would have preferred that this work had fallen into abler hands, but such as it is, I think it will not be without interest.

The drawings from which the illustrations have been made were executed by Miss Jack, Wm. McIntosh and Charles F. B. Rowe. My thanks are due to them, and also to a number of others who have aided me with suggestions and information. I am in hopes that the publication of these notes will lead to an increased interest among our members in the collection and study of such remains of the aborigines as may be found in our province. The number of such objects now in museums is very small, and there can be no doubt that a diligent search by students would be amply rewarded.

Stone with Conical Holes.

The block of coarse sandstone (pl. vi) containing curious conical holes was found with a few others like it, in the summer of 1899, by Mr. Duncan London, at Ring Island, south-west side of Maquapit Lake, Queens Co., N. B.

It is rudely rectangular in shape, its greatest width being 8¼ inches, and its greatest length 11 inches. The block has an average thickness of 2½ inches, and weighs 10½ pounds. The name "cup stones" has been applied to stones with these cavities, and they are remarkable in that they are found in many parts of the world. In some parts of Europe they occur upon the megalithic monuments, and are often polished smooth. The cavities have been roughly made

by pecking, and occur only on one side. This specimen has on its surface 26 of these conical holes. These range in size from $1\frac{1}{8}$ of an inch in diameter, by $\frac{1}{2}$ inch in depth, to a size very much smaller. Though differing in size the holes are all similar, and apparently have been produced in the same way.

Dr. Rau has published a memoir* on these cavities, and inclines to give them a religious rather than a utilitarian character. It seems

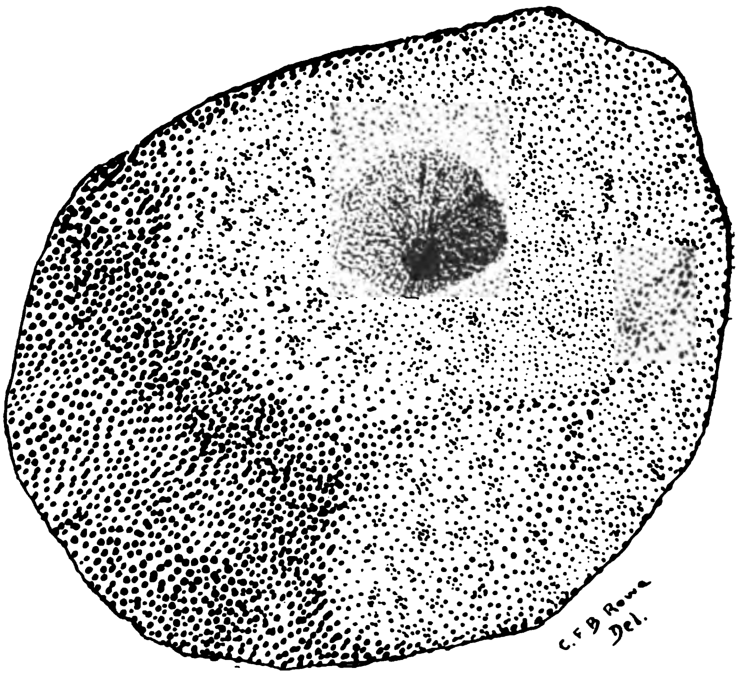


FIG. 1. PITTED STONE. (Natural size).

more probable, however, that they are the accidental product of some ancient manufacturing process. Sir John Evans† thinks that similar stones found in caves of the Reindeer Period of the South of France were probably used as mortars. The specimen I have here figured could have been readily held on the knee by a workman and used for such a purpose.

* Contrib. to North Am. Ethnology, Vol. V.

† Ancient Stone Implements, p. 220.

Dr. G. F. Matthew,* in his account of the excavations made at Bocabec for the study of the kitchen-middens there, states that the chipping of the lance and arrow heads was in some cases performed beside the fire-place, on stones or supports placed near the fire.

Mr. Harry Piers† informs me that no relic like the one here described has yet been found in Nova Scotia.

Pitted Stone.

Fig. 1 (p. 288) represents a roughly rectangular block of fine grained sandstone, with a conical hole pecked in obverse and reverse sides. The stone is about 4 inches long, 3 inches wide and 2 inches thick. It weighs 1 lb. 9 ozs. The pecking seems to have been done with a sharp flint, and the marks of the tool can be plainly seen. The holes are exactly like those referred to in the next preceding note. The depth of the holes is three-eighths of an inch. This stone could have been held with the thumb and forefinger and used as a hammer-stone, but it shows no marks of having been used for such a purpose.

It was collected with two similar specimens by Mr. Duncan London on Ring Island, Maquapit Lake, in August, 1899, and by him presented to the Society. I am not aware that anything of this kind has yet been found in other parts of the province.

Grooved Axe.

Among relics of the stone age which have been found in the central part of New Brunswick, stone axes are the most common, and a good many specimens are to be found in collections. In other parts of the province, however, they are more rarely found, and at Bocabec, Dr. Matthew notes a remarkable scarcity of axes.

Dr. R. Nicholson, of Newcastle, has placed in my hands a grooved stone axe (fig. 2) which differs from any axe in our collections in the angular character of the groove and in the form of the head. It was picked up in about three feet of water in the Restigouche River, opposite Dawsonville, in the summer of 1888.

It is 4 inches long, the edge, which measures 2⅝ inches, is rounded, and the elliptical head has a flat hammer-like surface 2⅝ inches long.

* Bulletin X. of this Society, p 17. † Letter to author.

and $1\frac{1}{2}$ inches wide. It weighs $17\frac{1}{2}$ ounces. The groove of the axe is smooth, except at the edges, and vertical to the shoulder, rectangular in shape and slightly rounded at the corners.

The owner of this implement could use it either as an axe or a hammer. It was produced by natural wear from a fine grained

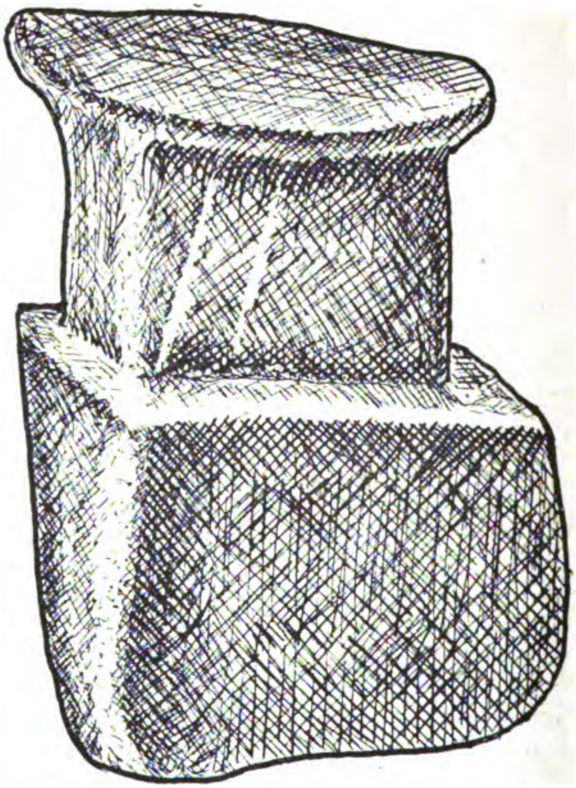


FIG. 2. GROOVED STONE AXE. (Natural size).

argillaceous altered sandstone boulder, which had a band in the upper part more calcareous than the rest.

When exposed to the weather the more calcareous material decomposed and was worn off, thus producing the groove, and in this condition it was found by a man of the stone age. His eye saw that with little labor it could be fashioned to suit his purposes, and when

he had done some pecking to the lower part of the groove, he possessed a finished axe. Thus nearly all the peculiarities of the axe are traceble to natural causes.

The remarkably flat poll of this axe distinguishes it from all other stone axes known to me, and is traceable to the causes referred to above. A number of specimens in our collections show this quickness on the part of the aborigines to pick from boulders forms that with small labor would answer their special purposes.

Pendants.

Different names have been given to the objects shown in plate vii. The terms gorget, tablet, breastplate and pendant, have been used by different writers. It is possible that such stones were worn as charms as well as for purely ornamental purposes.

The material from which the specimen shown in fig. 1, plate vii, has been made is a dark silicious clay slate, through which a thin band of quartz runs a little below the hole. This band of quartz stands out distinctly from the surface of the pendant, and as it must originally have been uniform with the surface it follows that the softer slate has been removed by weathering. This indicates that the specimen is of considerable antiquity, and not a product of more recent times.

The hole, which shows signs of wear, has been bored obliquely, and could have been readily done with a flint or quartz tool. The edges have been gently rounded, and its appearance indicates that it was a weather worn piece of stone, requiring little work to reduce it to the required form. It is 5 inches long, $\frac{1}{4}$ of an inch thick, and measures at its widest part $1\frac{5}{8}$ inches.

It was found in 1899 on a flat near the mouth of Cain's River, Northumberland County. The finder used it for some time as a whetstone, and then gave it to Professor W. F. Ganong.

In the museum of the University of New Brunswick are four pendants in a fragmentary condition, which Professor L. W. Bailey has kindly placed in my hands for description.

The first of these (fig. 2, plate vii) is made from micaceous slate, and shows two perforations. Both holes have been bored somewhat obliquely, but not so much so as in the case of the pendant first described. Two borings were started, but not completed. The borings were made from each side, and in the hole on the right hand

margin the boring was driven from the reverse side to within a short distance of penetration before a boring was started from the other side. In the case of the other hole, the borings meet about midway. The holes shows no signs of wear. The specimen is one-quarter of an inch thick, and was found at Ring Island, Maquapit Lake.

Fig. 3 (plate vii) represents a broken pendant of dark argillaceous slate bevelled so as to make three sides on each face. The central division has, cut into it, an ornamented design of short diagonal lines. The work has been very neatly done, and shows good taste on the part of the artist. The reverse side is not ornamented.

Fig. 4 is another pendant of dark argillaceous slate, and ornamented in the same way as fig. 3, but the diagonal lines are very close together. The object is bevelled so as to have three faces on each side. The ornamented face is one-eighth of an inch wide. Reverse side is not ornamented.

Fig. 5 is part of an ornament of greenish grey slate. It has a very characteristic Indian decoration, and, with the two preceding specimens, was found at Indian Point, on Grand Lake. It is bevelled so as to have three faces on each side, the central face being the widest This specimen is ornamented on all six sides.

Bone Harpoons.

Implements of bone and ivory which have been used by men of the Stone Age are not common in America. This is probably due to the fact that bone is a more perishable article than stone, and, unless protected from the weather, soon decays. In Europe a good many implements of this nature have been found in caves, but in America comparatively little has been done in that interesting field of exploration.

The implements of bone and ivory that have been found in this province have been for the most part recovered from the kitchen-middens of the southern coast, and do not exhibit any great variety. So far as I know, very few implements of bone have been found in the central or eastern parts of the province.

In 1869 Prof. Spencer F. Baird explored shell heaps in Charlotte County, and published,* in 1882, an account of his explorations that

* Proc. U. S. Nat. Museum, 1882, p. 292. He says, "The examinations of the shell beds in New Brunswick and Eastern Maine were made mostly in the summer of 1869."

aroused local interest in this work; and at this time a fine set of harpoons was found on the farm of Joseph A. Simpson, Oak Bay, Charlotte County. These are the property of Miss Vroom, of St. Stephen, and she has very kindly placed them in my hands for study. When found, these implements were neatly stored in a bone case, which was struck and partly split by the ploughshare which turned it up. The case (pl. viii, fig. 1) is a moose bone, which after it had been stripped of its flesh, and the marrow extracted by its aboriginal owner was roughly squared at each end and used as a convenient receptacle for the three harpoons. This case is $7\frac{3}{4}$ inches long, and at its base shows tool marks, indicating a desire on the part of its owner to take off the rough edges. Five lateral cuts, which occur near the base, may have been marks of identity. When found the opening of the case was roughly square-ended, but two triangular pieces have since been broken off.

As I have said, when found, the three harpoons were contained in this case, but in withdrawing them for examination one (pl. viii, fig. 4) was broken, and the larger portion of it has since been lost.

Figs. 2 and 3 (pl. viii) represent the only two perfectly preserved harpoons that have been found in this province, and differ somewhat from others that are known to us.

In the case of fig. 2, we have a well-formed straight implement with eight barbs on one side and a single barb on the other. This harpoon is $6\frac{7}{8}$ inches long, and at its widest part measures half an inch. The barbs are about one-quarter of an inch apart, with the exception of the fourth, which is only one-eighth of an inch above its predecessor.

In fig. 3 we have a simpler implement, six inches long, with a single barb on each side, though not exactly opposite each other. A channel $2\frac{1}{4}$ inches long occurs on the lower part of this harpoon.

Fragmentary remains of harpoons were found by Dr. G. F. Matthew in his excavations at Bocabec, but the specimens found there were barbed only on one side.

These harpoons were employed by the aborigines in the capture of fish, and were probably attached to a wooden shaft. We know from the records of the early explorers that to the natives of the Passamaquoddy region fish were an important article of food, a part of the province where indeed they still abound.

Pipes.

Of aboriginal remains the pipes used by the former inhabitants of this country are among the most interesting objects. On pipes the early races of America placed great store, and much care was given to their manufacture. The pipe had its place at the council, the great feast, and at ceremonial observances of various kinds.

In the United States, and in western Canada, many objects of this kind have been found, and large numbers have been placed in museums. In this province, however, very few pipes have been found. The museums at Washington, Ottawa, Toronto, Fredericton, and Chatham, contain no specimens from New Brunswick. It seems fitting, therefore, to figure and describe the few that have been found within our borders.

Father Pierre Biard, in his Relation of New France* (1616), gives the following reference to the smoking habits of our Indians, as observed by him. He says: "They also use tobacco * * * It is the sole delight of these people when they have some of it, and also certain Frenchmen are so bewitched with it that to inhale its fumes they would sell their shirts. All their talks, treaties, welcomes and endearments, are made under the fumes of this tobacco. They gather round the fire chatting and passing the pipe from hand to hand, enjoying themselves in this way for several hours. Such is their inclination and custom."

I am inclined to think that the use of the pipe had not been long introduced before the arrival of Europeans in this Province. In 1869 Professor Spencer F. Baird† made careful investigation among the shell heaps of some parts of Charlotte County, and he found no remains of pipes.‡ In 1883 Dr. G. F. Matthew,§ assisted by other members of this society, made a thorough investigation of some hut bottoms at an undisturbed Indian village at Bocabec, and he found nothing to indicate that the former inhabitants of this ancient village were smokers.

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* Jesuit Relations and Allied Documents, Vol. iii., p. 117, edition of Burrows Bros. Co., Cleveland, 1897.

† Aboriginal Shell Mounds of New Brunswick and New England. (Proc. U. S. National Museum for 1881, Vol. iv. (1882), pp. 292–297.) New Brunswick shell deposits treated on pp. 292–295.

‡ Letter from U. S. National Museum, February 6, 1900.

§ Bulletin of this Society, X., 1892, pp. 6–29.

Monitor Pipe.—Under the name of "monitor" pipes, Mr. J. D. McGuire has described and figured a style of pipe which has been found in many parts of eastern North America, and also among the aboriginal remains recovered from the mounds.

Fig. 3, plate ix, shows a pipe of this kind now in the collections of this society. It was found in 1897 on a gravel knoll on the farm of Francis Doherty, at New Ireland, Albert county (on the headwaters of the Upper Salmon River). It is made of dark green chlorite and is in a battered condition. Portions of the surface which have not been injured show a high polish and indicate that originally this was a handsome pipe. The bottom of the stem is flat, and at its widest part measures one and a quarter inches, narrowing to seven-eighths of an inch. On top the centre of the stem is marked by a well-defined ridge. The stem hole, one-quarter of an inch in diameter, is smoothly and evenly drilled, and Mr. McGuire considers that in these pipes the drilling has been done with steel tools. The rim of the bowl has been partly broken away; the interior, which is one and seven-sixteenths inches deep and thirteen-sixteenths of an inch in diameter, is elliptical in shape and perfectly smooth. The stem is ornamented with incised lines at right angles to it, and there are indications that the rim of the bowl has been adorned in the same way. The height of rim of bowl above ridge of stem is one and one-eighth inches; length of pipe two and one-quarter inches.

Micmac Pipe—This pipe (fig. 1, pl. ix) was found by one of our corresponding members, Dr. A. C. Smith, in the summer of 1899, at an old Indian camping-ground, on the land opposite South Tracadie Gully. Associated with it were a number of other articles of undoubted aboriginal manufacture, such as stone arrow-heads, spear-heads, etc., an account of which will be published in our next Bulletin.

This pipe is two and one-eighth inches in length, and the material of which it is made is a fine dark slate. It has a thin keel one-sixteenth of an inch in width at bottom, and thickening to one-eighth of an inch at junction with the stem. This keel has seven holes, apparently bored partly from each side, as the holes are largest at the surface and smallest at the centre. The first and second holes are somewhat larger than the others, and the boring has been done while the pipe was held an an angle to the body of the worker. The keel has

been broken away from the bottom of the sixth and seventh holes.

Guire* says that these holes, usually from one to six in number, were for the purpose of attaching tassels and strings to prevent loss in the snow. It is possible, too, that feathers may have been thrust through these holes for ornamental or ceremonial purposes.

Professor Perkins† has described a pipe from the Champlain valley with a perforated keel, but differing in other details from this pipe.

The opening of the stem hole has a diameter of five-sixteenths of an inch, gradually narrowing to about half that size. It was probably drilled evenly at first, and afterwards the opening enlarged by gouging to admit a stem of wood or bone. The bowl is missing, and was probably quite small. The boring connecting with stem hole is three-eighths of an inch in diameter and very evenly drilled. The upper part of the stem on both sides of the bowl shows, on close examination a number of small facets, while the sides are worn and smooth.

This pipe was probably smoked with the aid of a long wooden stem, and from the size of the bowl must have been more for ceremonial use than personal enjoyment.

This is a typical Micmac pipe, and one of the most pronounced types of aboriginal pipes.‡

STONE PIPE BOWL WITHOUT STEM.—Some months ago Mr. R. Jardine, a member of this Society, told me that a number of years ago at Sheffield, in Sunbury County, he had seen stone pipe bowls which he thought were of Indian origin. I had therefore thought it probable that specimens would be found. Not long afterward Mr. Archie Hay placed in my hands a stone pipe bowl (fig. 2, pl. ix) only partially completed, and so of very considerable interest. It was found by him on the site of the old Indian village of Meductic, and the material is a light brown argillaceous freestone (sandstone). The block from which it was formed gives evidence of having originally been part of a celt, though the material is not the best for such a purpose. In length it is 1½ inches, in height 2 inches, and 1¼ inches wide. It was evidently the intention to reduce the height, but the work was only partially done. The bowl and stem hole have both been roughly

*Am. Aboriginal Pipes and Smoking Customs, 1899, p. 630.

† Pop. Science Monthly, Dec. 1893.

‡Am. Pipes and Smoking Customs, 1899, p. 630.

excavated, and the work on them was never completed. The bowl is so shallow ($\frac{5}{8}$ of an inch deep) that it is possible that part of the top has been broken away. The stem hole is $\frac{5}{16}$ of an inch in diameter narrowing to $\frac{1}{8}$ of an inch.

Unlike many similar stone pipes, this specimen shows no signs of having been made with the aid of metal tools. A flake of quartz or chert would work well on such material, and probably some such implement was used. When completed and ready for use the pipe would have been fitted with a stem of wood or bone.

IROQUOIS PIPE.—The pipe (Pl. ix, fig. 4) belonging to Professor Bailey is one of great interest. It was found some years ago in the basin below Aroostook Falls, and is in good preservation.

A description was given in a former Bulletin*, but as many copies of that number were issued without plates, I have thought it well to again draw attention to it.

It is a clay pipe, and on the inner side of the bowl, facing the smoker, the aboriginal artist imprinted a human face. It is a well baked piece of pottery, of which the body is dark grey, and rather coarse, and the exterior is covered with a reddish glaze, due to improper firing. A gloss has been produced on this paste, by rubbing, before the baking. In the depressions, however, round the mouth and eyes, there is no gloss, so the shining surface may be partly due to use. The color is reddish brown, but on portions of the bowl and stem dark patches appear. The interior of the bowl shows a fire crack on each side, nearly an inch long, produced in the baking of the pipe. The bowl is thick, and the bore of small capacity—$1\frac{3}{4}$ inches in depth—trumpet shape, and narrowing down from a diameter at rim of $\frac{5}{8}$ of an inch to $\frac{1}{4}$ of an inch where the stem hole enters. The rim is decorated with a lattice work pattern of incised lines about $\frac{1}{8}$ of an inch in length. The ornamentation is nearly obliterated by wear. This pipe clearly belongs to the type which McGuire calls "Iroquoian," from the observed fact that it is the type found distributed over that area of North America formerly inhabited by the northern Iroquoian tribes.

It is well known that the Mohawks were in the habit of making forays into this province, and on such an occasion this pipe may have been lost.

* Bulletin of this Society, No. VI.

SOAPSTONE PIPE.—Figs. 3, *3a* and *3b* show side and end views of a dark soapstone pipe, neatly inlaid with lead and tastefully decorated with incised circles, curves, dots and geometric designs. Below the stem hole, near the base, a hole has been bored so that the bowl could be fastened to the stem to avoid loss in the snow. Prof. W. F. Ganong tells me that he has seen in two or three museums in Ontario dark soapstone pipes inlaid with lead in the same way as this specimen, though not of the same pattern. A specimen in the museum of the

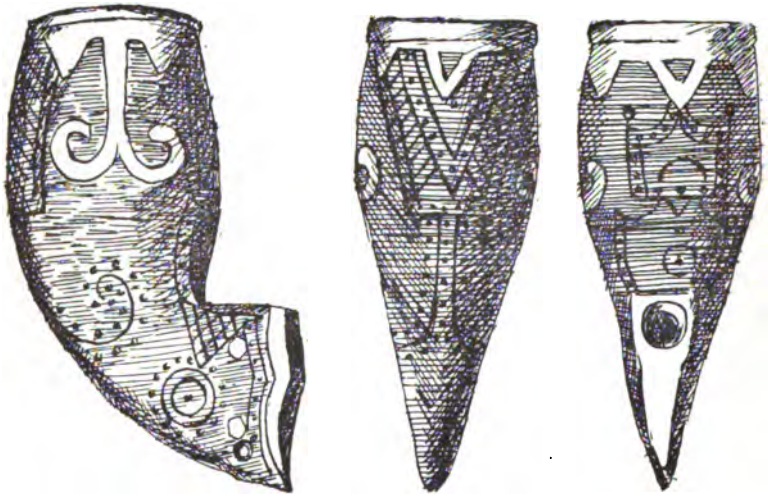

FIG. 3. *3a* *3b*

SOAPSTONE PIPE, inlaid with lead. (Natural size).

Natural History Society, Montreal, is labelled "Indian pipe, inlaid with bullet metal. Formerly used at the trading forts on the central plains."

This specimen is the property of Dr. I. Allen Jack, who has kindly placed it in my hands for study. It was given to him in 1871 by Mr. Geo. W. Rowley, at that time manager of the Bank of Montreal at Newcastle, N. B. I sent a drawing of this pipe to Mr. David Boyle, curator of the Ontario Archæological Museum, and, in a letter among other things, he says: "As far as I am aware, the specimen you figure is the most easterly find of the kind, and is valuable on that account. As Prof. Ganong's remarks indicate, such specimens

are common in the North West. We have several in our museum, but none having a similar pattern. We have them of soapstone, limestone and catlinite, all inlaid, and all from the North West. It is impossible to say how the pipe could have reached your part of the country; one can only guess. We know that some Indians travelled great distances from their habitat, and in this way the pipe may have come to you, or it may have been brought by some missionary or trader."

Miss Emma Jack has kindly furnished the drawings of this pipe.

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ILLUSTRATIONS.

Plate VI.

Stone with pecked conical holes. Holes shows a pecked surface, and none of them are smooth, or show concentric striation. Size, 8½ x 11 x 2½.

Plate VII.

Figure 1. Pendant of dark slate, from Cain's River, Northumberland County. Natural size.

Figure 2. Fragment of pendant or breastplate. Found at Ring Island. Natural size.

Figure 3. Broken pendant from Indian Point, Grand Lake. Natural size.

Figure 4. Ornamented pendant, of dark slate, from Indian Point, Grand Lake. Natural size.

Figure 5. Ornamented pendant, of greenish grey slate, from Indian Point, Grand Lake. Natural size.

Plate VIII.

Figure 1. Hollow bone, in which the harpoons were encased when found at Oak Bay, Charlotte County.

Figure 2. Barbed bone harpoon, 6¾ inches long.

Figure 3. Barbed bone harpoon, 6 inches long.

Figure 4. Fragment of a bone harpoon.

Plate IX.

Figure 1. Stone pipe of "Micmac" type, from land opposite South Tracadie Gully. Natural size.

Figure 2. Unfinished stone pipe bowl, from Fort Meductic. Natural size.

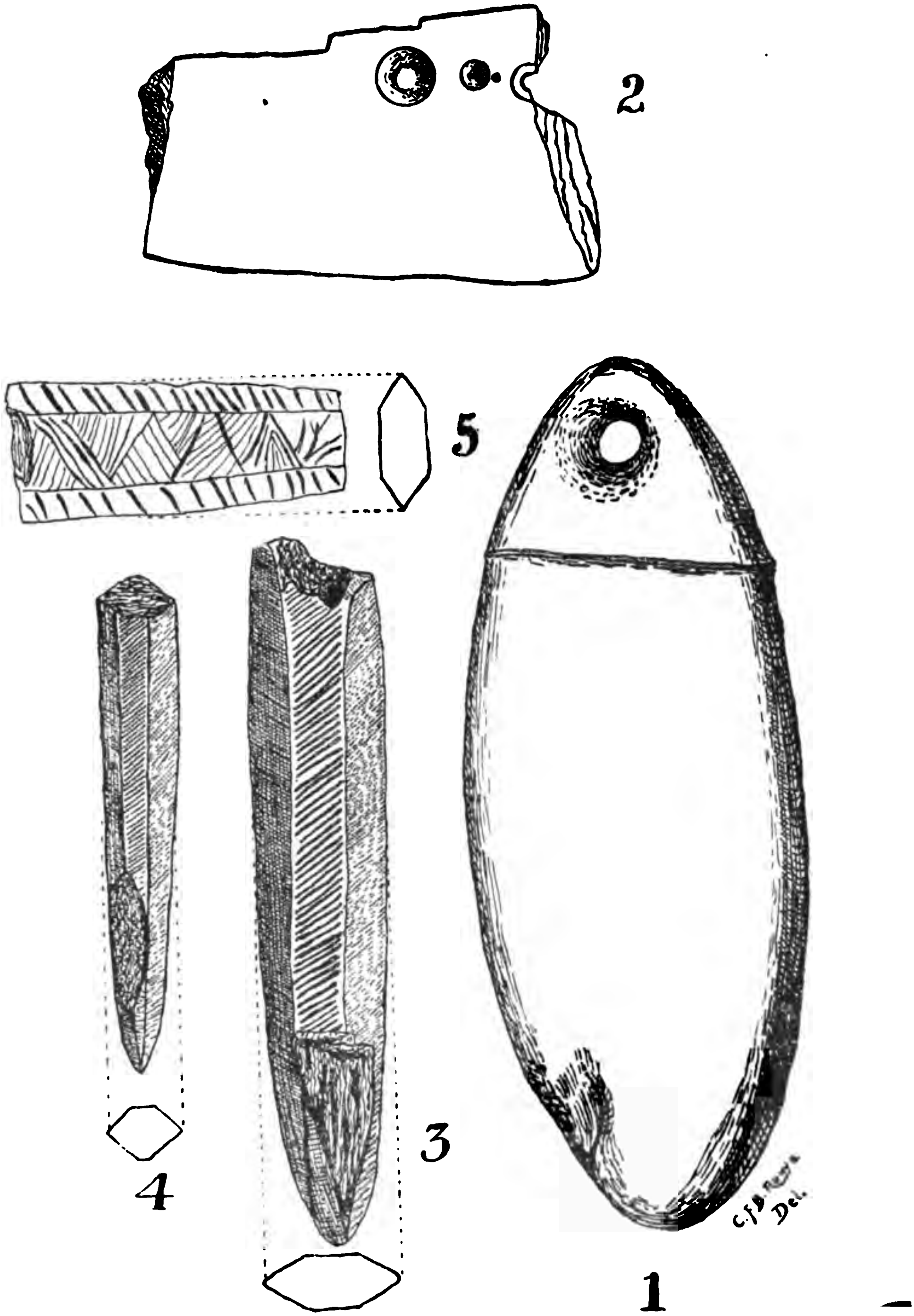
Figure 3, Chlorite pipe, of "monitor" type, from Albert County. Natural size.

Figure 4. Clay pipe, of "Iroquois" type. Natural size.

PLATE VI.

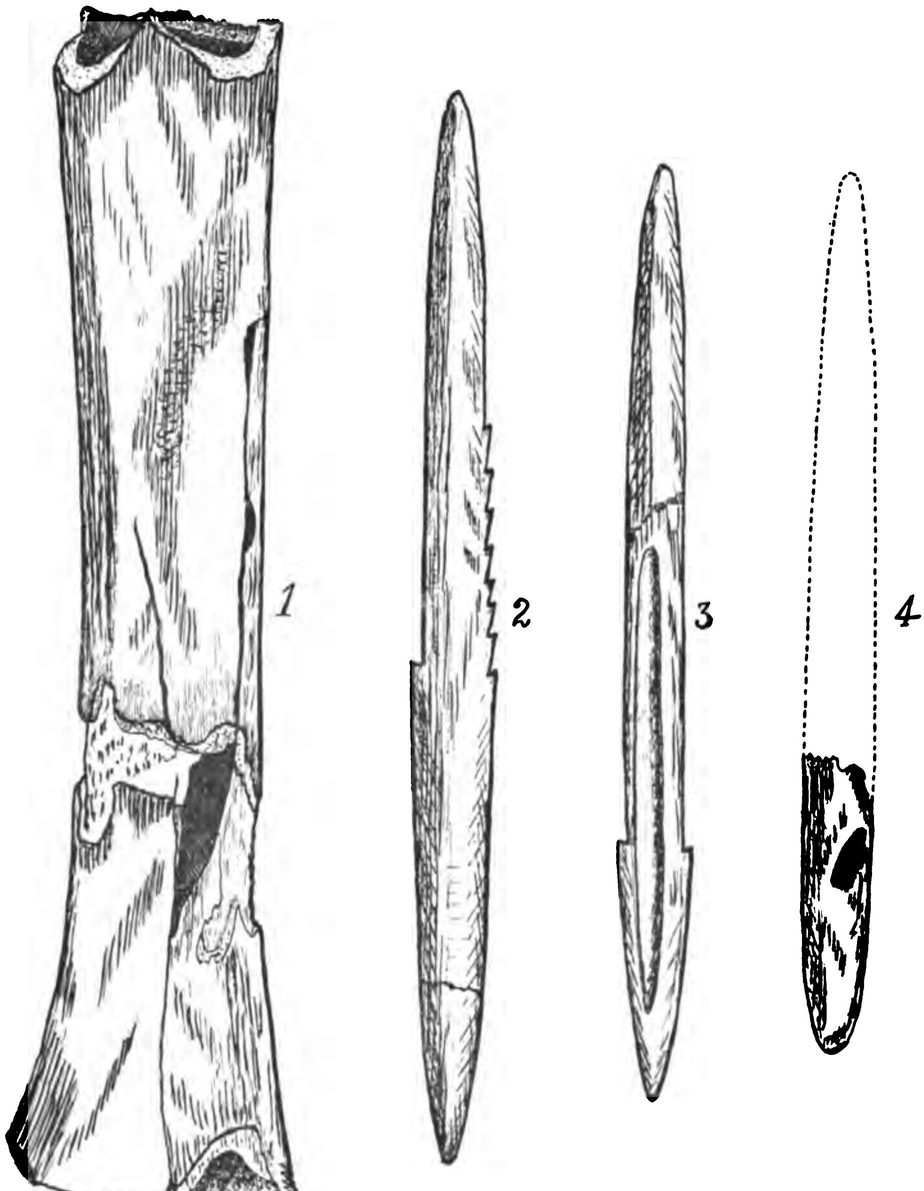
STONE WITH CONICAL HOLES. REDUCED.

PLATE VIII.



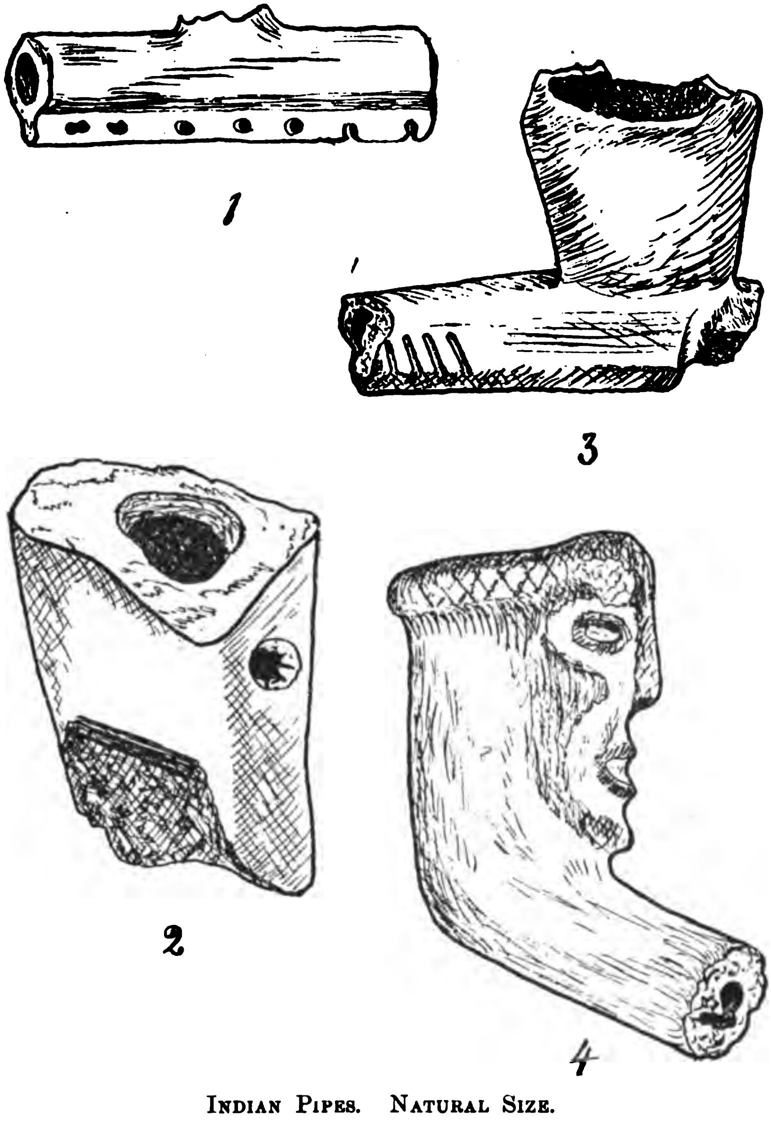
Stone Pendants. Natural Size.

PLATE VII.



Bone Harpoons. Slightly Reduced.

PLATE IX.



Indian Pipes. Natural Size.

ARTICLE III.

THE HAWK AND BOMBYCINE MOTHS OF NEW BRUNSWICK.—INTRODUCTORY LIST.

BY WILLIAM MCINTOSH.

(Read November 6, 1900)

The present paper constitutes my third article on the Lepidoptera of New Brunswick, and relates to the insects which are known as Hawk and Bombycine Moths.

The list is incomplete, being merely an enumeration of the more prominent species found near St. John.

I desire to express my obligation to Dr. James Fletcher, of Ottawa, and Dr. Herman Strecker, of Reading, Pa, for their determination of doubtful species.

SPHINGIDÆ.

MACROGLOSSINÆ.

Hemaris, *Dalm.*
  Diffnis, *Bdv.*
  Thysbe, *Fabr.*

CHŒROCAMPINÆ.

Amphion, *Hbn.*
  Nessus, *Cram.*
Deilephila, *Ochs.*
  Gallii, *Rott.*
  Lineata, *Fabr.*
Ampelophaga, *Brem & Gray.*
  Choerilus, *Cram.*

SPHINGINÆ.

Protoparce, *Burm.*
  Celeus, *Hbn.*
  Carolina *Linn.*
Sphinx, *Linn.*
  Kalmiæ, *S. & A.*
  Drupiferarum, *S. & A.*
  Lucitiosa, *Clemens.*
  Chersis, *Hbn.*
Ceratomia, *Harr.*
  Undulosa, *Walk.*

SMERINTHINÆ.

Triptogon, *Brem.*
  Modesta, *Harr.*
Smerinthus, *Latr.*
  Geminatus, *Say.*
  Cerisyi, *Kirby.*
Paonias, *Hbn.*
  Excæcatus, *S. & A.*
Cressonia, *G. & R.*
  Juglandis, *S. & A.*

SESIIDÆ.

Sannina, *Walk.*
  Exitosa, *Say.*
Sesia, *Fabr.*
  Tipuliformis, *Harr.*

AGARISTIDÆ.

Alypia, *Hbn.*
  Octomaculata, *Hbn.*
Eudryas, *Bdv.*
  Grata, *Fabr.*

SYNTOMIDÆ.

Lycomorpha, *Harr.*
  Pholus, *Dru.*

CTENUCHIDÆ.

Ctenucha, *Kirby*.
  Virginica, *Charp*.

LITHOSIIDÆ.

Hypoprepia, *Hbn*.
  Fucosa, *Hbn*.

ARCTIIDÆ.

Crocota, *Hbn*.
  Immaculata.
Utetheisa, *Hbn*.
  Bella, *Linn*.
Platarctia.
  Parthenos, *Harr*.
Arctia, *Schrank*,
  Virgo, *Linn*.
  Saundersii.
  Virgincula, *Kirby*.
Phyrrharctia. *Pack*.
  Isabella, *S. & A*.
Phragmatobia, *Steph*.
  Rubricosa, *Harr*.
Leucarctia, *Pack*.
  Acræa, *Dru*.
Spilosoma, *Steph*.
  Virginica, *Fabr*.
Hyphantria, *Harr*.
  Cunea, *Dru*.
Halisidota, *Hbn*.
  Tessellata, *Harr*.
  Maculata, *Harr*.

LIPARIDÆ.

Orgyia *Ochs*.
  Leucostigma, *S. & A*.
  Antiqua, *Linn*.

NOTODONTIDÆ..

Datana, *Walk*.
  Ministra, *Dru*.
Nadata, *Walk*.
  Gibbosa, *S. & A*.
  Stragula, *Grt*.
Lophodonta, *Pack*.
  Ferruginea.
Pheosia. *Hbn*
  Rimosa, *Pack*.
Edema, *Walk*.
  Albifrons, *S. & A*.
Schizura, *Doub*.
  Ipomœæ, *Doub*.
  Unicornis, *S. & A*.
Ianassa, *Walk*.
  Lignicolor, *Walk*.
Heterocampa, *Doub*.
  Guttivittata, *Walk*.
  Biundata, *Walk*.
  Manteo, *Doub*.
  Umbrata, *Walk*.
  Pulverea, *Walk*.
Cerura, *Schrank*..
  Occidentalis, *Lint*.

PLATYPTERYGIDÆ.

Platypterix, *Lasp*.
  Arcuata, *Walk*.
Dryopteris, *Grt*.
  Rosea, *Walk*.

SATURNIIDÆ.

Attacus, *Linn*.
  Cecropia, *Linn*.
Actias, *Leach*.
  Luna, *Linn*.
Telea, *Hbn*.
  Polyphemus, *Cram*.

CERATOCAMPIDÆ.

Dryocampa, *Harr*.
  Rubicunda, *Fabr*.

BOMBYCIDÆ.

Clisiocampa, *Curtis*.
  Americana, *Harr*.
  Disstria, *Hbn*.
    Var erosa, *Strech*.
    Var sylvatica, *Harr*.

HEPIALIDÆ.

Hepialus, *Fabr*.
  Argenteomaculatus, *Harr*.

ARTICLE IV.

ACROTHYRA.

A New Genus of Etcheminian Brachiopods.

By G. F. Matthew, LL. D., F. R. S. C.

(Read January 8, 1901; published January, 1901.

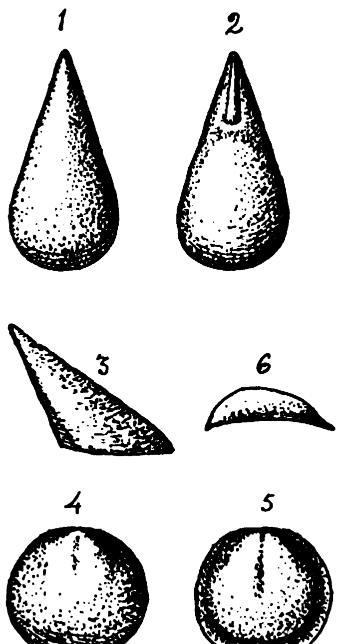
In studying the earliest strata of the Eo-Palæozoic of the island of Cape Breton in Nova Scotia, Canada, the author has met with a form already described in the pages of this Bulletin as an Acrotreta,* but which from more perfect knowledge of the shape, habits and structure, he now thinks should be set off as a separate genus with the following characters:

Quite small Brachipods having the ventral valve elongate-conical, with the apex either overhanging the cardinal line, or but little in front of it. Orifice nearly circular, often oblique. *Interior* with a long, narrow, or a quadrate visceral callus, extending forward from the foramen about a third of the length of the valve and widening as it goes.

A distinct, usually high, cardinal area extends from the foramen to the cardinal line.

Dorsal valve as in Acrotreta.

The difference in the form of the ventral valve distinguishes this genus from Acrotreta and is accompaniedby difference of habit, etc. In Acrotreta the visceral callus is



Acrothyra proavia, mut. *prima*—1, Ventral valve—2, Mould of the same—3, Same in profile—4, Dorsal valve—5, Mould of the same—6, Same in profile. All magnified $\frac{10}{1}$ Upper Etcheminian Shale, C. Breton, N. S.

* Acrotreta proavia, this Bulletin, vol. iv., p. 203.

concentrated around the foraminal passage, and the shell appears to have been of sedentary habit, since the ventral valve in many cases is found fossil in such an attitude as to show that this valve stood in a vertical position in the mud of the sea bottom when the animal which inhabited it was living, the opening of the valve being uppermost. No such uniformity of attitude characterizes the dorsal valve.

We find that the ventral valve in Acrothyra assumes quite a different attitude. It lies in almost all cases on its side, and usually with the opening of the valve uppermost. Moreover, it is to be noted that on successive layers these valves lie with the umbo oriented in a fixed direction. From this it may be inferred that they give evidence herein of the action of a current, flowing in a definite direction and sweeping the valves in the diroction towards which the current set. They may have swung in this direction by the pedicle while the animal was living; or when swept away by the flowing water, have presented the point of least resistance to the current, as they sank to the bottom. In either case we must regard Acrothyra as living under different conditions from Acrotreta, which, as we have remarked, apparently had the apex of the ventral valve buried in the mud.

It is in accordance with these conditions that we have in Acrothyra a visceral callus developed along the median line of the ventral valve, as is the case in Lingula and other allied genera; and Lingula, as is well known, had a long pedicle.

This genus is peculiarly Etcheminian, there being two species and several varieties or mutations in the strata of this age. It seems likely *Lingulella* (?) *inflata* of the Protolenus Fauna belongs to Acrothyra; if so, the genus ranges up into the base of the Cambrian.

Conotreta, of Walcott an Ordovician (Trenton) genus, is a later development from the Acrotretoid phylum, differing in the form of the visceral callus, which is pointed in front, in place of expanding, as in Acrothyra. Analogy, however, would lead us to infer that this genus also was free-floating, and not sedentary, like many species of Acrotreta.

This type of Brachiopod—Acrothyra—is one of the earliest known in the Palæozoic rocks of Canada, being found in shaly layers in the midst of the eruptives which mark the advent of Palæozoic Time in Eastern North America.

ARTICLE V.

SOME RELICS OF THE EARLY FRENCH PERIOD IN NEW BRUNSWICK.

BY SAMUEL W. KAIN AND CHARLES F. B. ROWE.

(Read December 4, 1900.)

From time to time various articles relating to the early occupation of this province by the French have been deposited in the museum of this Society. Chief among these accessions are the articles donated by Dr. A C. Smith, of Tracadie, N. B., one of our most energetic corresponding members.

Jacques Cartier visited Miramichi Bay and Bay Chaleur in 1534, and from that time until the voyage of Champlain in 1604, there are many reasons for believing that numerous fishing and trading vessels visited our shores. These adventurous sailors carried on an active trade with the natives. The traders wanted furs, and for these they bartered iron tomahawks, knives, kettles, beads, etc. A brief account of such articles used in the trade as we have in our museum, with some others, may be of interest to our members and of some practical use to future investigators.

Kettles.

Before the arrival of Europeans the aborigines made rude earthen vessels. No perfect specimens of these have yet been found in New Brunswick, but from such fragments as have been recovered, it would appear that these articles were quite small. They were also heavy,* and, as Dr. G. F. Matthew has pointed out, were very fragile on account of being imperfectly burned. The metal kettle of the Europeans was therefore very much desired and highly prized.

* Bulletin of this Society, No. X, p. 14, 1892.

Champlain in his "Voyages" (Vol. II., pp. 83-84) narrates the following incident which occurred at Nausett Harbor, Mass.: "On the 23rd of July (1605) four or five sailors having gone on shore with some kettles to get fresh water * * * some savages coveting them, watched the time when our men went to the spring and then seized one out of the hand of the sailor," with the result that the kettle was lost and the sailor slain.

These kettles have been found in many parts of Canada and are generally made of copper or brass.

Three of these kettles were found in 1879 at Tabusintac interred with human remains. Dr. A. C. Smith brought the discovery before the Society and an account of the find was published.* In this connection it may be of interest to quote what Champlain says in his Voyages (Vol. II., pp. 191-192) about burial customs of the Indians at Quebec: "When a man or woman dies, they dig a pit in which they put all their property, as kettles, furs, axes, bows, arrows, robes and other things. Then they place the body in the pit and cover it with earth." In 1899, Dr. A. C. Smith sent to the Society an account of the finding of some graves of the early French period at Wilson's Point, Shippegan. Here stood an old French fort, now washed away, which has been described by Prof. W. F. Ganong† and is marked on his map as "Denys' Fort:"

The following is an extract from a letter by Dr. Smith to the Society, dated at Tracadie, Sept. 19, 1899: "Four circular depressions in the ground, about 100 feet from the shore, were noticed by two men who happened to pass through the woods. In one hole they found the copper kettle which I will forward in a few days. In the kettle they found the skull, arm bones and ribs, but the bones of the lower extremities were outside of the pot. Over the mouth of the vessel was the skin of some animal, and over the skin birch bark. I saw the circular skin covering, but it was too sodden to bring away. In the other holes were found pots, axes, a sword, knives, a harpoon, and a pair of bracelets. In a small pot were some beads."

In a letter written some days later he adds:

"The round holes were four in number; about three feet in diameter and about four feet apart. Clearly they were graves; and

* Bulletin V., pp. 14-19, 1886.

† Proceedings Royal Soc. Canada, Vol. V. (Sec. series) Sec 11, pp. 207-209, 1899,

there are no indications of anything else in the vicinity. Since writing you, I have found on special enquiry that there were human bones in two of the holes. A button was found with the bracelets; but I have failed to get either. From a *reliable* friend who saw the button, I learn that the button face 'which was as bright as gold,' had a face of a man on it, surrounded by a halo, and a cross at the side of it.' About forty-five years ago a metal box, containing a written document, was found *about* a mile from these graves, but the writing could not be read as the paper was 'rotten.' The box had been cased in birch bark.

"About two years ago, an Indian grave was broken into not far from the site of the graves I write about. I visited the spot and found that the occupant had been buried in a sitting posture;* the hole was deep, but not more than three feet in diameter. The bones were very much decayed: nothing else was found in the hole."

We have in our museum three of these kettles from Tabusintac, and four from Tracadie. It has been reported that similar kettles have been found at Indian Point, Grand Lake. The kettle shown in plate x, fig. 4, was found by Dr. Smith, under the circumstances just described. It is of copper, 21½ inches in diameter, 12 inches deep, and has a capacity of 15 imperial gallons. The handle is of iron, rectangular in section and passing through copper ears, strongly fastened with three copper rivets to the body of the kettle. The bottom is nearly flat and gently rounded at the sides. This kettle weighs twenty pounds and Mr. Hevenor says the value of a similar vessel now would be about $10.00.

The other pots from Tracadie, three in number, are small, the smallest being six inches across the mouth and four inches deep.

The kettles from Tabusintac differ in some respects from those found at Tracadie. In the Tracadie kettles the sides are neatly turned over an encircling iron rod so that the rod is not seen. In the Tabus-

*Father Baird, in his Relation of New France, 1616 (Jesuit Relations and Allied Documents, Vol. iii., pp. 129, the Burrows Brothers Co., Cleveland, 1897) says: "They bury the dead in this manner: first, they swathe the body and tie it up in skins: not lengthwise but with the knees against the stomach and the head on the knees as we are in our mother's womb. Afterward they put it in the grave which has been made very deep, not upon the back or lying down as we do, but sitting. A posture which they like very much, and which among them signifies reverence. For the children and the youths seat themselves thus in the presence of their fathers, and of the old whom they respect. We laugh at them and tell them that way of sitting is the fashion with monkeys, but they like it and find it convenient."

intac kettle, the top sides of the kettle are flattened into a rim three-quarters of an inch wide, and beneath this the kettle is encircled by a broad iron band, to which are welded two circular iron ears for handles. All the Tabusintac kettles have the inner side of rim decorated with diagonal markings, and the handles are distinguished by a peculiar prolongation of the ends beyond the "ears," of from 3 to 3½ inches, and at right angles to the sides, as shown in plate xi., fig 4. In two of the Tabusintac kettles, the shape of the bottoms is that of a compressed cone.

Sword.

The double-edged, sharp pointed sword, shown on plate 10, fig 1, was found by Dr. A. C. Smith, in 1899, along with other articles in one of the circular graves at Tracadie. It is very badly rusted. The length of the blade is 2 feet 1½ inches, the handle, 3½ inches, and the widest part of the blade measures 2¾ inches. This sword may have been a present to a chief from the French, or it may have been the sword used by a medicine man in his incantations.*

Knives.

Among the articles found by Dr. Smith, at Wilson's Point, were a number of knives, plate xii., figs. 4-5. They are all badly rusted and about six inches long. They have originally been mounted with wooden handles. Fig. 3 represents a knife in much better condition than the preceding found at Tabusintac in 1879. Knives seem very highly valued by the Indians, and Cartier† records that on his first voyage (1534) he gave some knives to the savages in the very region where our specimens were found.

Harpoon.

The badly rusted iron harpoon, shown in fig. 5, plate x., was found in 1899, by Dr. A. C. Smith at Wilson's Point, Shippegan, along with the articles described on a preceding page. It is ten inches long, and though badly rusted, shows evidence of having been a strong

* Jesuit Relations and Allied Documents, III., p. 119.

† "We sent two men ashore with hatchets and knives, beads and other merchandise, at which they showed great joy." Quoted by Prof. Ganong in Canadian History Readings, p. 14, 1900.

implement. It was probably fitted to a wooden shaft and used in the seal fishery which flourished during the period of the early French occupation.

Axes.

Before the arrival of Europeans, the natives used axes of stone. At the best, these were unsatisfactory tools, and in the European iron axe they recognized a good thing. These axes early became an important article of trade, and were sent to America in large numbers. Hundreds of these have been found in Ontario, but with us they are not so common.

Fig. 2, plate x., shows a badly rusted iron axe, found by W. C. Simpson, at L'Etang, Charlotte County, and now in our museum. The eye is oval in shape, the length of the axe is eight inches, and it weighs one and three-quarter pounds.

Fig. 3, plate x., shows a well preserved iron axe in our museum, labelled, "Tomahawk of Milicete Tribe." This poled form, Mr. David Boyle says, is not common in Ontario. In this specimen, the pole measures 2½ inches, the length of the axe is 7½ inches, the rounded cutting edge is 2¾ inches and the weight is one pound.

Iron Gouges or Scrapers.

Dr. Smith recovered from the graves at Tracadie three curved iron tools that may have been used as gouges or scrapers. They are all pretty badly rusted, but one specimen (fig. 1, pl. xii,) is sufficiently preserved to give a good idea of these tools. It is about 5½ inches long, and the curved scraping edge is 1⅝ inches wide. This specimen has a knob at the end of the handle. Mr. T. W. E. Sowter* has described and figured very similar implements from Lake Deschenes, in the Ottawa Valley. He says: "Mr. Boyle inclines to the belief that from the small bulb or knob at the end of the handles, they may have been used by means of pushing directly in the hand, perhaps as skin-dressers or flesh-scrapers.

The other specimen figured (fig. 2 and 2*a*, pl. xii,) is of different shape and badly rusted. The third specimen has a blade two inches wide.

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* Ottawa Naturalist, January, 1900, p. 234.

Leaden Crucifix.

The earliest French traders and settlers who visited this province were accompanied by missionaries zealous to spread Christianity among the aborigines. Many converts were made, and doubtless to such would be presented crucifixes, of which a specimen is shown in fig. 6, pl. xii. This crucifix was found in 1879 at the mouth of the Tabusintac River, at a depth of three inches in the surface loam, and presented to the Society by Dr. Baxter, of Chatham. The exact spot where found is shown on a small map published in Bulletin V, p. 15.

The cross is 2⅝ inches in height, and 1¾ inches in width. It is in one piece, the escutcheon holding the inscription and the figure have been made separately and afterwards soldered to the cross. There is a hole for suspension, and Monsignor Laflamme, who has examined the crucifix, is of the opinion that at one time a chaplet of beads was attached and later separated from it. The inscription is difficult to read, but Monsignor Laflamme considers that if complete it would be I. H. S., as such an inscription is found on several crucifixes.

Toy.

Prof. W. F. Ganong has in his possession a curious lead toy (figure 5, plate xi.) which was given to him by Prof. L. W. Bailey, in 1897. Professor Bailey bought two of them from a man who said he dug them up just below the mouth of the Oromocto. The specimen belonging to Prof. Bailey has on it the letters I. B. and a scratched "1740," which is probably modern. The toy represents an old time four-gun sloop of war, with high stern and ancient bowsprit. It would seem as if this object had been made in a wooden mould from bullet metal. The reverse side is perfectly smooth.

Beads.

The Indians were fond of beads for ornamental purposes. Before the advent of Europeans, they made them from shells, and in some cases from stone. Mr. Duncan London says that beads made from stone have been found in the vicinity of French and Maquapit Lakes, but we have no specimens in our museum. The women wore the beads strung around their necks, arms and wrists, and suspended from their ears.*

* Bulletin of N. H. S. of N. B., viii., 1889, pp. 12-14.

The early French traders introduced glass and porcelain beads in large quantities, and these soon displaced the native article. Most of the beads of this period to be found in the museum of this Society, and at the University, have been recovered from graves. Dr. Smith recovered a large number of colored beads of glass and porcelain from the graves at Tracadie. These were strung on fibres, which Professor Ganong determined to be the root fibres of the spruce. The various forms are shown on plate xi, fig. 2.

The museum of the University has a number of beads recovered from graves at Grand Lake, and very similar to those found by Dr. Smith. The large flesh-colored glass bead or pendant (plate xi, fig. 1) was found on the Washademoak River, and is in the University museum. It is octagonal in form and perforated from end to end.

Fig. 3, plate xi, shows a porcelain bead, evidently made in imitation of the old Indian wampum beads. Its surface is covered with cracks and the hole for suspension is very small. It was ploughed up in 1898, on his farm near Nerepis Station, King's County, by Geo. A. Harding, who gave it to the Society.

In early intercourse with our Indians, the belt or collar of wampum was used as a flag of truce, and served the same purpose as the pipe served in other parts of the continent.

Father Baird states* that beads were generally interred with the remains of women.

* Jesuit Relations, etc., Vol. III., p. 123.

ILLUSTRATIONS.

Plate X.

Figure 1. Sword, from Tracadie, 2 feet 5¾ inches long.
Figure 2. Iron axe, from L'Etang, Charlotte County, 8 inches long.
Figure 3. Milicete tomahawk, 7½ inches long.
Figure 4. Copper kettle, from Tracadie, 21½ inches wide and 12 inches deep.
Figure 5. Iron harpoon, from Tracadie, badly rusted. Length, 10 inches.

Plate XI.

Figure 1. Glass bead or pendant, found at Washademoak. Natural size.
Figure 2. Beads, glass and porcelain, from Tracadie. Natural size.
Figure 3. Porcelain bead, from Nerepis. Natural size.
Figure 4. Copper kettle, from Tabusintac. Depth, 7¼ inches; width, 17½ inches.
Figure 5. Lead toy, from Oromocto. Natural size.

Plate XII.

Figure 1. Front view of gouge, from Tracadie, 5½ inches long.
Figure 1*a*. Side view of figure 1.
Figure 2. Front view of gouge or scraper, from Tracadie, 4 inches long.
Figure 2*a*. Side view of figure 2.
Figure 3. Knife, from Tabusintac, about 6 inches long.
Figures 4–5. Knives, from Tracadie, about 6 inches long.
Figure 6. Leaden crucifix, from Tabusintac. Natural size.

PLATE X.

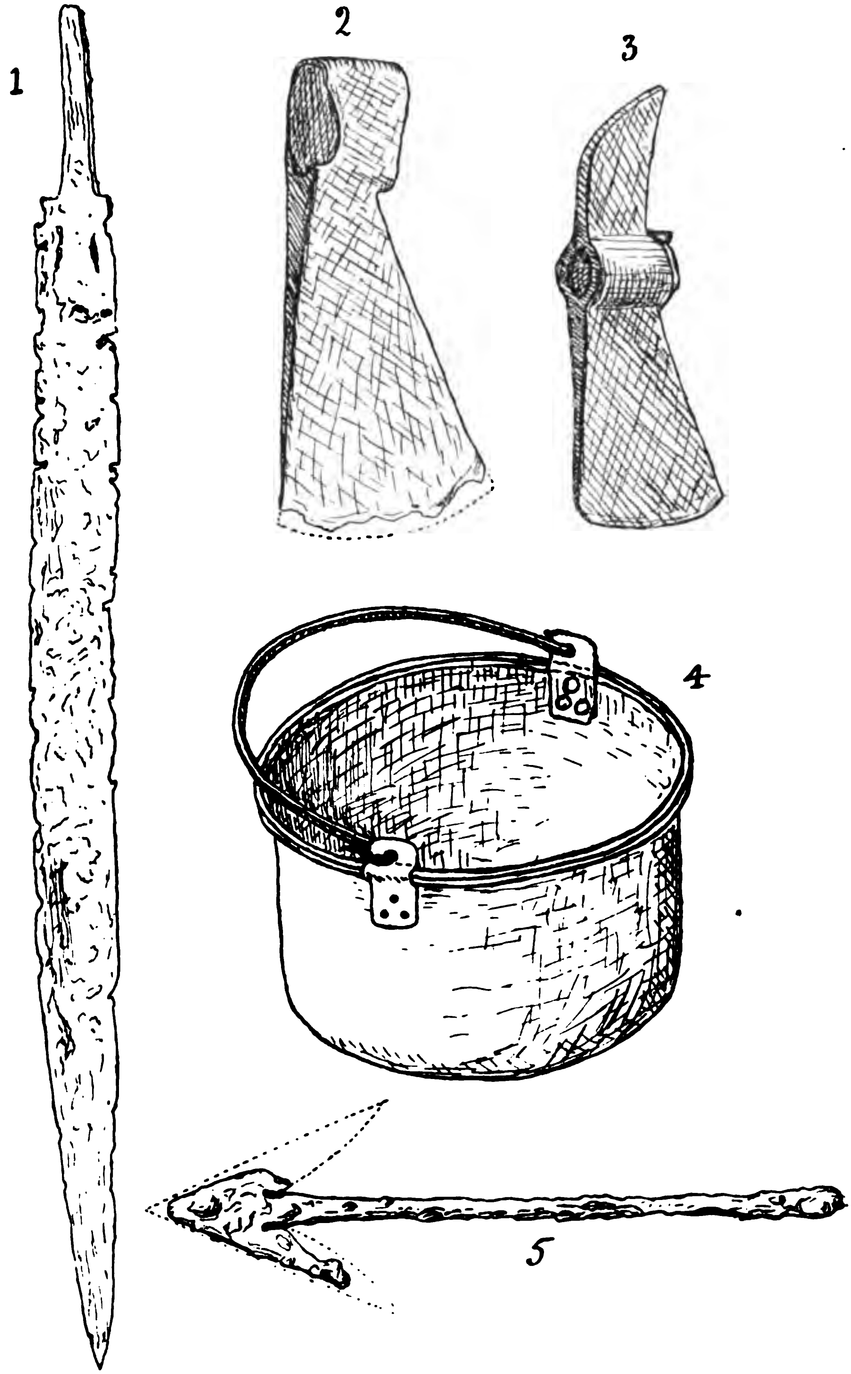


PLATE XI.

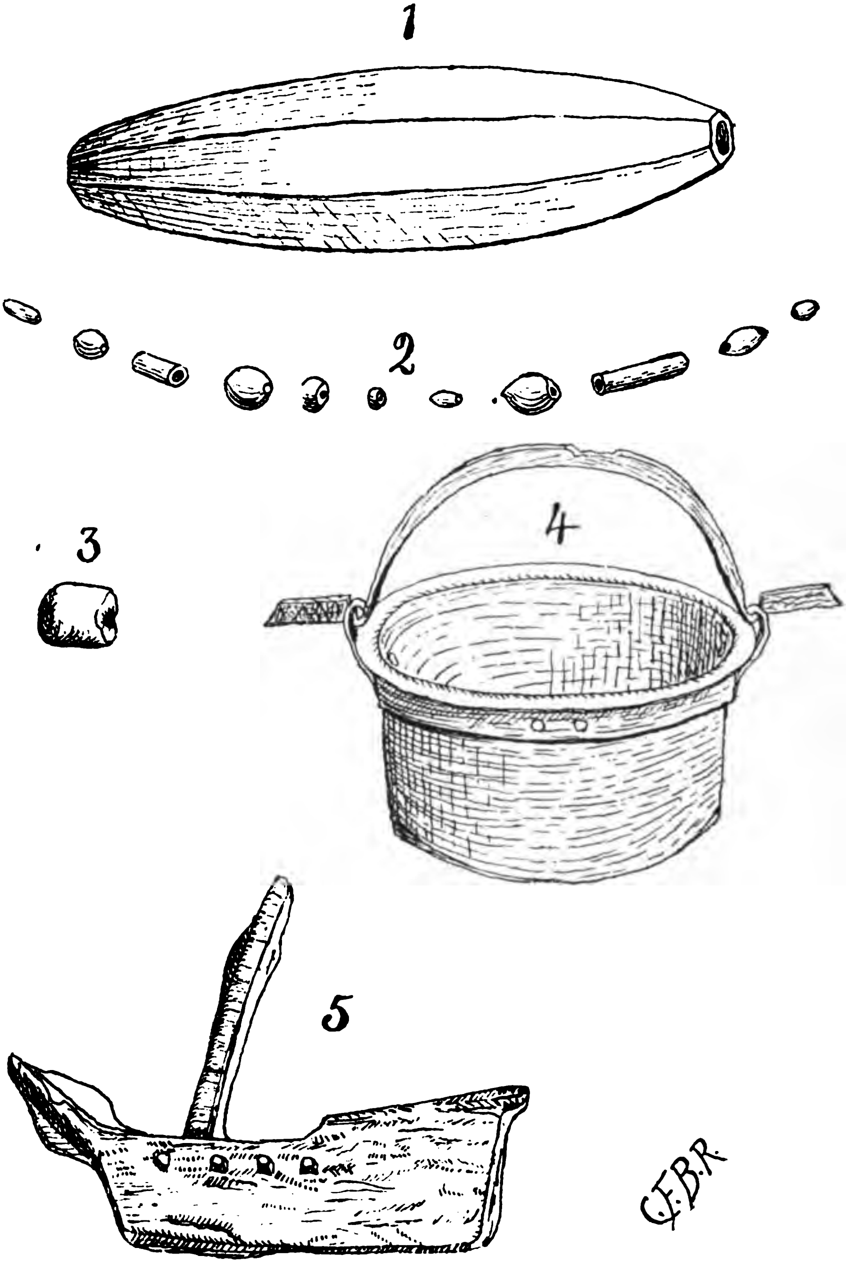
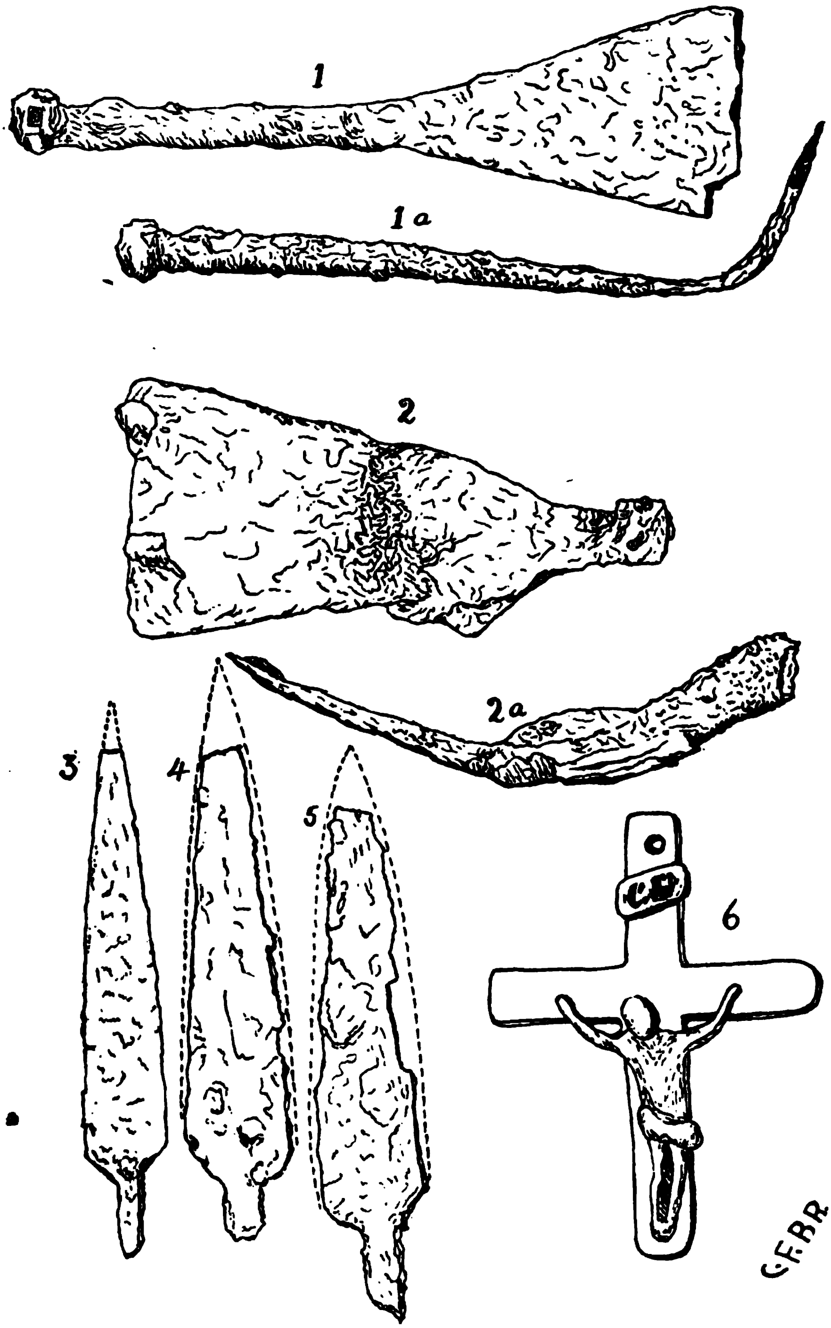


PLATE XII.



ARTICLE VI.

NOTES ON THE NATURAL HISTORY AND PHYSIOGRAPHY OF NEW BRUNSWICK.

By W. F. Ganong.

32.—The Physiographic Origin of our Portage Routes.

Everybody who has travelled much through New Brunswick by the primitive method, *i. e.*, the canoe, must have been struck by the remarkable arrangement of the rivers with reference to ease of travel in every direction. The St. John is the main artery of travel, and it sends large branches out to meet every large river on the Gulf and River St. Lawrence slopes on the one side, and to the branches of the Penobscot on the other; and between the streams which thus head together there are usually short and nearly level portages. Moreover, there are equally easy cross-communications between the smaller rivers, so that the province was covered by a network of these routes of travel, a fact brought out strikingly by a map recently published in the Transactions of the Royal Society of Canada (v, sect. ii, page 213). So remarkable is this heading together of the rivers, with the accompaniment of easy portages, that it must be the result of some fundamental and widely operating set of causes. These are found, without doubt, in past changes in our rivers, which are continually changing their valleys, moving their watersheds and robbing one another's basins. The easy portages in nearly every case follow former valleys of one or the other of the streams they connect, and the heading together of the rivers is a result of the fact that the heads of what are now two streams, formerly were parts of one. This is not true of all portage routes, but it is true of most of them, as the Kennebecasis-Anagance, the Salmon River-Richibucto, the Tobique-Nepisiguit, the Grand River-Restigouche, etc. New Brunswick has been so long under erosion that there has been time for innumerable changes in her valleys,

a subject of the greatest interest, to which I shall return in a future note.

In these easy portage routes, moreover, we have an excellent example of the correlation which exists between physiography and history. It was, for instance, the great ease of connection between the St. John waters and the Penobscot, and through the latter with other rivers to the southward, which allowed of those sudden and deadly forays of our Indians against the New England settlements, which in turn led to the voyages of reprisal by Church and others which play so large a part in the early history of the province.

33.—The Physiographic History of the Nepisiguit River.

In the whole of the attractive science of physiography, there is no subject of greater importance or interest than the changes which river valleys undergo in the course of their evolution. Rivers are forever extending their basins and moving their watersheds, while frequently they capture other rivers. Hence it comes about that some rivers are composites of two or more streams originally separate.

A river with a simple uneventful history would possess a fairly direct general course, a drainage basin of somewhat regular outline, and a valley increasing in width and decreasing in slope from source to mouth. Very different from this is the Nepisiguit. Twice in its course it bends permanently at right angles; it has a remarkably irregular drainage basin, and a valley which, through most of its extent, lessens in breadth and increases in slope towards its mouth. Such a river must have had a complicated history, and it is, I believe, a composite of four different river-systems. The evidence for this view will now be briefly presented, as worked out during the two trips I have made along its entire length.

The Nepisiguit shows four very distinct portions (see accompanying map),—first, the lakes at its source and its upper valley to Silver Brook; second, the portion thence to below Indian Falls, scenically by far the finest part of the river; third, the portion thence to Nepisiguit Brook; and fourth, the part thence to the mouth It will be convenient to consider these separately.

The Nepisiguit Lakes are about 1,000 feet above mean sea level, and stand about 150 feet above the Nictor Lakes, with which they are

connected by a narrow valley rising but slightly above the surface of Nepisiguit Lakes.* All the evidence seems to show, as Mr. Chalmers has clearly pointed out,† that the valley of these lakes in pre-Glacial times emptied by way of Nictor Lake into the Tobique, and with them must have gone the upper part of the Nepisiguit valley, at least to near the Third Fork Branch. There is also a low valley between these lakes and the Mamozekel, indicating perhaps a still earlier flow of these waters through that river. This part of the Nepisiguit was in all probability a part of one of the primitive valleys of the old pre-Cambrian streams flowing out of these highlands northwest into the pre-Silurian sea, which then occupied all of the northwestern part of New Brunswick.

We pass now to the second part of the river. From Silver Brook to Indian Falls the river flows amidst great hills swiftly but smoothly over gravel in a deep drift-bottomed valley, with some rips among boulders, but no ledges, at least none across the stream. Eastward the valley grows broader, gradually developing a flood-plain, until Portage Brook is reached. Portage Brook occupies a very broad, and evidently ancient, valley, by which there is a low and easy portage to Upsalquitch Lake, which lies 100 feet lower than the mouth of Portage Brook. This valley is a continuation of the valley of the main river, which here turns to the south, as far as the Main South Branch, which runs in a continuation of the same valley. It seems plain, then, that the Main South Branch, the main Nepisiguit to Portage Brook, Portage Brook itself, and Upsalquitch Lake all occupy a very ancient valley formerly emptying northward. Below the Main South Branch the river-valley still has a flood plain, is broad, and has the least rapid current of any part of the whole river; but it gradually narrows, and the flood plain disappears, until Indian Falls is reached. This part of the valley, therefore, broadens and shows greater age westward, though the part above broadens and shows greater age eastward. Now the peculiar relationship of the main river here to the great valley of the Main South Branch-Main River-Portage Brook-Upsalquitch, can only be explained by supposing that the latter valley was at one time the main stream emptying into the Upsalquitch, draining the pre-Cambrian highlands northward into

* See the map accompanying note No. 30 (Bulletin xviii, 250).

† See his Reports, Geological Survey of Canada, 1885, GG; 1887, N.

a pre-Silurian sea; and the present Nepisiguit above and below it were branches entering it at different points. (See accompanying map). This, I believe, was the case. The source of the west branch of this river would probably have been near the present Silver Brook, perhaps that brook itself. A branch must have eroded its way northward deeply enough so that the choking of the Nepisiguit Lake-Nictor Valley with Glacial drift (or possibly some earlier cause) turned the Nepisiguit Lake waters from the Tobique into the Nepisiguit, thus explaining the curious southerly bend of the valley at this point. Possibly the Third Fork Brook is the continuation of this branch. The source of the eastern branch must have been somewhere to the eastward of Indian Falls. In fact the valley continues to narrow eastward until, just below the Forty-mile Brook, the river bed nearly fills it; but probably the ancient source was not so far east. The geography of this upper part of the river appears to me not to have been altered materially by the Glacial period. The trains of boulders forming the occasional rips are no doubt remnants of old Glacial dams, the gravel of which is now distributed along the river bed. The great depth of this part of the valley has prevented the formation of Glacial falls.*

At Indian Falls the river drops a few feet amongst huge boulders and over ledges evidently in a post-Glacial channel. I could not identify the pre-Glacial channel, but from the top of Mount Denys (Bald Mountain) one can see what appears to be an old channel marked by a heath on the north bank.

Below Indian Falls the character of the river changes entirely. Its current is much swifter and more broken, both by huge boulders and by more frequent ledges. The country rapidly diminishes in elevation, soon becoming a great peneplain, into which the river has cut some 200 to 300 feet. The valley continues to narrow to somewhat below Forty-mile Brook, where, as already stated, the river bed nearly fills it. Below this it broadens a little, at least in places, until Nine-mile Brook is reached. Along this part of the river are some fine lofty gravel terraces culminating in a particularly fine one, specially mentioned by Mr. Chalmers, just below the mouth of that brook. Just below this terrace occur huge boulders in great number, forming

* On the relationship of depth of valleys to absence of falls. See earlier note 8, (Bulletin xvi, 52).

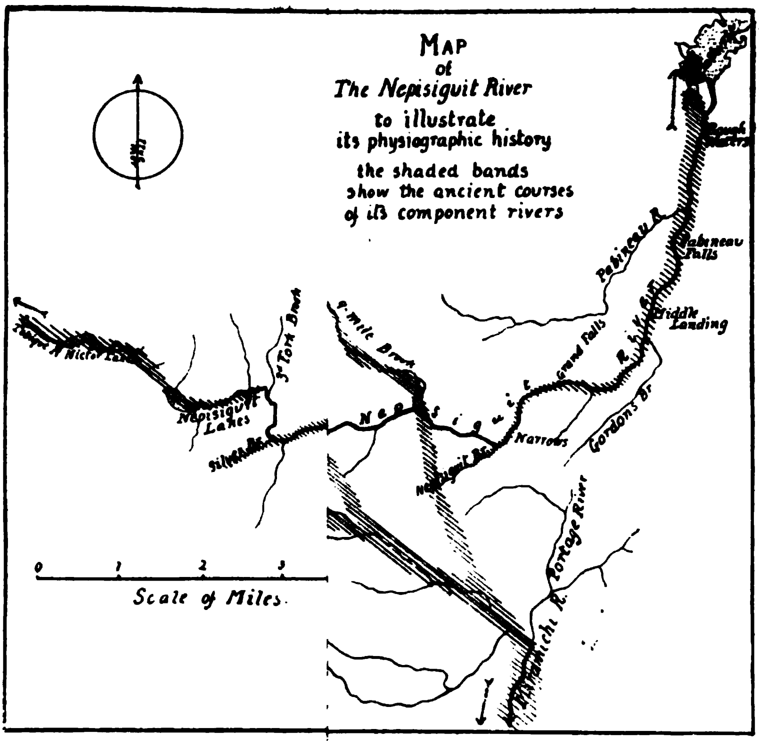
some of the worst rapids on this part of the river; but below, as far as Nepisiguit Brook, the terraces are very few and low. It seems clear, then, that this terrace and the boulders are remnants of a great Glacial dam at this point. That there was such a dam somewhere along this river is mentioned by Mr. Chalmers, but he puts it at the Narrows, a long distance below, an impossible theory as it seems to me, because of the different character of the terraces above and below this point. Below Nine-mile Brook, to near the Narrows, the valley becomes very narrow and the banks almost precipitous, so that one is inclined to consider this part of the river as post-Glacial. It is not, however, a true post-Glacial gorge, and the low terraces are against this view, but certainly it must be geologically one of the newest parts of the river,* indeed excepting only the post-Glacial gorges at the Narrows and at Grand Falls, the very newest part of the whole river. At Nepisiguit Brook, half a mile above the Narrows, the valley suddenly opens out and assumes the shallow, ancient appearance which it holds to its mouth. This part of the river, from Indian Falls to Nepisiguit Brook, is very puzzling, and I have not been able to form any clear idea of its probable mode of formation. Considering, however, the general parallelism of Forty-four-mile, Forty-mile and Nine-mile Brooks with the branches of the Northwest Miramichi, together with the extremely limited extent of the drainage basin of the river on the south side, it seems very probable that the aforementioned streams were formerly branches of the Miramichi, which have been captured to the Nepisiguit by the gradual backward extension of the lower Nepisiguit,† though I can form no idea as to the influences determining this peculiar extension. Certainly all this part of the main Nepisiguit must be comparatively new, much newer than the upper part of the river.‡

* This part of the river crosses a band of rocks considered by Ells to be probably pre-Cambrian, but this fact does not in itself explain the peculiar newness of this part of the valley. It is just possible that an older valley exists between Nine-mile Brook and the river below Nepisiguit Brook, or even between Nine-mile Brook and just above Grand Falls.

† One must not, however, put too great faith in the accuracy of the maps, for they have many errors. All such studies as the present are greatly hampered and rendered uncertain by the absence of a good map of the province based upon a unified survey.

‡ It is of course possible that the branches may have connected with the Miramichi, but by routes very different from those shown by the shading on the map. The other possibility is that there never was a connection of this river with the Miramichi, but the main river is a part of an ancient stream flowing eastward from the edge of the pre-Cambrian highlands across the Cambro-Silurian region into the Carboniferous sea; but the new part between Nine-mile Brook and the Narrows is very difficult to explain on this basis.

Passing now to the lowermost portion of the river, we must consider both its Glacial and its pre-Glacial history. Mr. Chalmers has expressed the opinion that much of the lower part of this river is post-Tertiary, a conclusion with which I cannot entirely agree. The Narrows is a typical gorge eroded out since the Glacial period, and the pre-Glacial valley is evident on the north bank. For about half a mile above the Narrows the valley is very open and apparently ancient, and possibly Nepisiguit Brook was the original source of this part of the river. Below the Narrows the same open character is kept, and a marked feature of the river are occasional isolated cliffs, marking ancient rock ridges through which the river long ago cut its way. The hills diminish in height until the Grand Falls is reached, where there is a fine fall and gorge. Mr. Chalmers states there is no pre-Glacial valley around this fall, a statement quite incomprehensible to me, for below the gorge is a large basin, from the north side of which a low drift-filled valley starts westward towards the head of the fall. It is true I have not followed it through, but the whole appearance at the basin is precisely that of a pre-Glacial valley now drift-filled. Below the Falls the valley for the most part is very broad and open, but it is broken at Chain of Rocks, at Middle Landing, at Pabineau Falls, at the Rough Waters, and a few minor points by bad rapids or falls over ledges; and at these points the valley is obviously post-Glacial. But these falls occupy only a part of its course, and between them the river is very different in character, and has all the appearance of an old partially drift-filled valley. The whole country here is a low peneplain, and the valley is very shallow; this shallowness has allowed of its easy damming in many places by Glacial drift and its deflection from its old course, whence the many falls. In places the river follows the contact line of the Lower Carboniferous and the Granite, and probably that was its course throughout in pre-Glacial times. I believe that this valley, though of course geologically newer than the upper part of the river, is much older than post-Tertiary. The course of its lower part is in line with the Northwest Miramichi, and both occupy a valley created by the rise of the country to the eastward. Indeed it is probable that this original Nepisiguit at one time headed near Portage River, for Gordon (or Portage) Brook continues it in a straight line on one of its bends (wrongly shown on the map), and is largely a sluggish stream connected by a low portage with the Miramichi. In


Map
of
The Nepisiguit River
to illustrate
its physiographic history
the shaded bands
show the ancient courses
of its component rivers
0 1 2 3
Scale of Miles
Nepisiguit Lakes
3rd Fork Brook
Nepisiguit
Grand Falls
Narrows
Gordons Br.
Portage River
Pabineau R.
Middle Landing

this case the part from Gordon Brook up to Nepisiguit Brook was at first but a short branch, which later worked back to its present position, and became the main stream. Below the Rough Waters comes the head of tide, three miles from the mouth of the river. Here the valley seems clearly pre-Glacial, but a mile below it becomes typically post-Glacial to its mouth, while the old valley may be traced, south of Bathurst, across the peninsula to Little River basin.

The Nepisiguit, then, I submit, is a composite of four rivers, a small portion from the Tobique system, a very large part from the Upsalquitch system, a part from the Miramichi system, while the lower portion is the true original Nepisiguit, which has worked back at its head, gradually capturing and making tributary to itself the aforementioned parts of the other systems.

I am well aware that these conclusions rest largely upon very scanty data, but I shall have accomplished one of my objects if I succeed in calling to these problems the attention of those better equipped than I am for their solution.

34.—On the Heights Above Sea Level of Nictor Lake and Neighboring Places.

In an earlier note of this series (No. 29) and on the map accompanying Note No. 30, the height of Nictor Lake is given as 864 feet. This figure is the average of those obtained by Wightman (corrected), Chalmers (on the Geological map) and myself. Mr. Chalmers calls my attention to the fact that the height of 878 on the Geological map is an engraver's or printer's error, and that the height as determined by him was really 828 feet, as given in his Geological Report (for 1885, GG, 17). I had noticed this discrepancy between map and report, but as the map with its 878 feet agreed so closely with Wightman's corrected figures, *i. e.* $777 + 100 = 877$, I concluded it was correct, and that the figures in the report were a misprint. This unfortunate error on the geological map does not, however, vitiate any of the figures given in my notes or maps except two, namely, the height of Nictor Lake itself, which should read 847 instead of 864, and Mount Gordon which should read 1552 instead of 1569. All other heights in that vicinity were compared with other datum levels, and hence are independent of the error as to Nictor Lake.

The most interesting and most important fact brought out by the measurements in the vicinity of Nictor Lake is that Mount Carleton is higher than Sagamook. In confirmation of the testimony of the aneroid measurements, I may add the following facts. Standing upon the highest point of Carleton one can look clear over the summit of Sagamook, and see the hills on the horizon beyond except in one small spot where they dip down below their average level; but as seen from Sagamook, Carleton stands out against the sky without anything showing beyond, though the hills are higher to the south than to the north. Again, in order to settle their relative heights, I took with me a spirit-level and tripod. When set level on the summit of Carleton and sighted upon Sagamook, the horizontal line of sight passed clean over it; when the same level was sighted from Sagamook upon Carleton, the horizontal line of sight struck Carleton considerably below its top. This evidence is conclusive as to the *relative* heights of the two.

35.—Peneplains and Monadnocks in New Brunswick.

As earlier pointed out (Note 26) we have in New Brunswick two good examples of great peneplains, the eastern Carboniferous plain and the Northern Silurian plateau. Peneplains frequently possess islands or remnants of the old materials left behind in the general planing down of the surface, and such islands are called monadnocks. Have our New Brunswick peneplains any monadnocks? When one stands upon the top of Bald Mountain (or Mount Champlain)* on the Kings-Queens boundary and looks off to the north-eastward, he will see what appears to be a very typical monadnock in the hill on which Marr Settlement is situated, which rises abruptly from the plain east of Grand Lake. It is not, however, a real monadnock, for, as Dr. Matthew informs me, though of Lower Carboniferous age, it is composed of a ridge of volcanic rocks, and hence remains, not because it is left behind in the general erosion, but because it resists erosion better than the surrounding rock. The larger elevation north of Grand Lake on which the Emigrant settlement stands is of similar nature. As to the Silurian plateau, there appears to be a typical monadnock in Green River Mountain, which stands up prominently

* On this name see the next note.

above the surrounding country. Possibly, however, the Geological map is not correct in making it of the same formation as the surrounding country, for it marks Squaw Cap and Slate Mountain in Restigouche as Silurian when they are really intrusive volcanic. Mars Hill is perhaps an imperfect monadnock. An example of a seeming, and perhaps a real, monadnock is Bald Head in Victoria County, which rises abruptly from a flat though limited plain It is of pre-Cambrian felsite, and now surrounded by later formations; but, not being intrusive, it must at some time have been isolated by erosion from the other felsite areas to the eastward.

36.—Further Suggestions Upon Nomenclature of Unnamed or Badly Named Places in New Brunswick.

The practical inconvenience arising from the repetition of the same name for different places in New Brunswick is not only at present considerable, but is sure to increase as the province becomes better settled. Attention was called to this subject not long ago in an editorial in the St. John *Telegraph*, which suggested that the mountains called Bald, so numerous in New Brunswick, should gradually be re-named. Practically, the best preliminary to this, is the suggestion of good alternative names. This has been done already by Governor Gordon for Bald Mountain on Nictor Lake which he called *Sagamook*, and the name has come into at least literary use; and lately the name *Denys* has been proposed as an alternative for Bald Mountain near Indian Falls on Nepisiguit (Note No. 30). Another Bald Mountain for which an alternative name is happily available, is that north-east of Harvey Station in York County. On a splendid manuscript map of New Brunswick, made in 1786, now in the Public Record Office in London, this mountain is called *Wadawamketch* Mountain, evidently an Indian name. For such natural features of the country as mountains, no names could be more appropriate than those of Indian origin, and they should be adopted in preference to all others whenever available. Another Bald Mountain which, however, seems to have no Indian name, is the fine one on the Kings-Queens boundary. An alternative name for it is certainly most desirable. What more appropriate name could it bear than that of the first great European explorer known to us to have gazed upon it, the discoverer of the St.

John, our first historian, a man as yet uncommemorated in any place-name in this province, *Champlain.* May it be known, for the future, as Bald Mountain or Mount Champlain.

Other names causing inconvenience by their repetition, are the Salmon Rivers. The Indian name for Salmon River flowing into Grand Lake is *Cheminpic* (Che-min′-pic) a not inharmonious name which would form an appropriate alternative.

There is yet another name which might have its use. There existed at one time a great Glacial lake, filling all the lower part of the valley of the St. John and its tributaries. Elsewhere such Glacial lakes are now named. Very appropriate for it would be the ancient Indian name of the St. John, after which it could be called *Glacial Lake Woolastook.* There is not likely to be any inconvenience in the use of this name for a Glacial lake and a physiographic district (Note 26).

37.—The Physiographic History of the Restigouche.

In an earlier note (No. 33) I pointed out what appears to be a very complicated history for one of our northern rivers, the Nepisiguit. Our northernmost river, the Restigouche, on the other hand, appears to have had a comparatively simple, though not uneventful, history. It rises in the great Silurian plateau some 500 to 600 feet above the sea, and flows easterly entirely through Silurian formation in a deepening, narrow, but very winding valley, lacking a flood-plain, unbroken by a fall and without even a bad rapid from source to mouth. The narrowness of its valley, the steepness of its walls, and the lack of a flood-plain (except for small intervales on some of the bends and at the mouths of some of the principal branches), show that it is a comparatively new river, while its winding course in its lower part shows that it must have originated in a very level country, on whose surface it wound about. Its upper part, however, above the Kedgewick, and especially above the Gounamitz or Little Fork, is somewhat different; it is there straighter and has less fall than the lower part, and runs in a very open country, into which it has not cut deeply. If, now, this upper part were being formed by extension backward of the lower river, it should, upon well-known principles of river-development, have a greater fall than the lower part. Moreover, the relation of the direction of the river to the Grand River through the low-lying Wagan

and Wagansis portages (see Geological map) makes it seem to me perfectly clear that the upper part of the river to beyond the Gounamitz formerly emptied into the St. John through the Wagan and Grand River, and it has been robbed from St. John waters by the backward extension of the Restigouche.* The great branches, Kedgewick and Gounamitz, must be subsequent rivers, and the Kedgewick, the largest of them, seems to have tapped the Rimouski system and appropriated its headwaters, as an inspection of the geological map shows to be probable.† The absence of falls and bad rapids is obviously due to the fact that the river has nowhere been turned out of its course by Glacial drift, and this in turn, for the lower part of the river at least, must be due to the depth of its valley; the drift could not fill it, and hence was easily washed out. The softness of the Silurian rocks and the ease of their erosion also probably have something to do with the freedom from rapids.

The Restigouche is probably therefore a composite river of three parts. By far the larger part is a comparatively new post-Silurian river, the main Restigouche; while the part above the Kedgewick has been robbed from the St. John, and a small portion of the Rimouski has been captured by the Kedgewick.

38.—On the Use of Mineral or Divining Rods in New Brunswick.

The use of divining rods in the search for hidden water, concealed mineral beds or buried treasures, is extremely ancient and widespread. The belief in their efficiency is very prevalent in New Brunswick, where they are generally known as "mineral-rods," and used not so much in seeking water (which is usually abundant enough in this favored province) as for locating suspected ore-beds or the treasure supposed to have been buried by Captain Kidd, the Acadian French or others. Odd or conspicuous places everywhere around the coast and on the lower courses of the rivers almost invariably show holes dug by credulous treasure-seekers, most of whom are known to have used the mineral-rod in their preliminary explorations. The subject

* Ells (Report, 1881, D. 18,) states that the river above the Patapedia occupies the crest of an anticline.

† This explains why the Kedgewick is so much larger than the main river.

has been investigated more or less thoroughly a number of times, and as a result, most scientific men consider, I believe, that there is no physical connection whatever between the performance of a mineral rod in the hands of an expert and the presence of minerals or water, but that the observed phenomena of movements of the rods, are all explicable upon known psychological principles of suggestion, association, etc. The expert users of the rods (for not all people are the proper kind of "medium,") are supposed to be those who combine great credulity with a power of subconscious observation and shrewdness in guessing probable localities, and this mental state reacts unconsciously upon the physical being, causing the rod to be turned downward in probable places. Hence the mineral-rods bend at certain places not at all from external (physical or objective) but entirely from internal (mental or subjective) causes. A somewhat different explanation, however, has recently been given, at least for the finding of water, by an English investigator, W. F. Barrett. He considers it possible that the user of the rod may hypnotize himself by the concentration of attention upon the point of the rod, and in that state become susceptible to influences from without to which others, and he himself ordinarily, are entirely insensitive, and that there may be some still unknown physical connection between the presence of water and the mental state of the user of the rod.

The origin of the belief in divining rods has been traced by Fiske in his "Myths and Myth-makers." Other important literature upon the subject may be found as follows: Nature, October, 1897, page 568, November, page 79; January, 1898, page 221; November, 1899, page 1. There is also a short article of interest in the St. John *Globe* for May, 15, 1900, and another in the same paper, Januuary 2, 1901. Most important of all are Barrett's two monographs in the Proceedings of the Society for Psychical Research, 1897 and 1900.

39.—On the Physiography of the Basin of the Negoot, or South Tobique, Lakes.

At the head of the south or "right-hand" branch of the Tobique River, in the very heart of the New Brunswick highlands, lies a group of lakes, which, while not including our most beautiful single lake (*i. e.* Nictor), nevertheless forms by far the finest group in the province.

They are entirely unsettled and wild, have been but little studied scientifically, and are imperfectly (in some cases, not at all,) mapped. Hence they form an attractive field for physiographic and natural history study.

History.— These lakes first make their appearance upon the Franquelin-DeMeulles map of 1686,* where two of them (one clearly Trowsers Lake, though no names are given,) are shown in about their proper relations with Little South-West Lake. Their next representation is upon the Lockwood map of 1826, on which they are laid down unnamed and very erroneously, but they are much better on the Baillie and Kendall map of 1832. In 1836–1838, however, the principal lakes, Trowsers (in part only), Long, Portage, Adder and Serpentine, were surveyed by Deputy Garden, and his results appear upon the later printed maps, especially Wilkinson's of 1859. The earliest printed reference to the lakes occurs in Governor Gordon's "Wilderness Journeys,"† in which the author's brief visit to Long and Trowsers Lakes in 1863 is described.‡ The next year Professor Hind visited the lakes; and he has given us in his well-known Geological Report of 1865§ a brief account of part of them, and his is the fullest description that has yet been published.

In 1884 the lakes were laid down on Loggie's large map with little or no improvement over Wilkinson, but in 1886 Mr. William McInnes, for the Geological Survey, visited the lakes, made observations upon their geology, took barometric measurements for their altitudes, and made a detailed micrometer survey‖ of Trowsers, Long and Serpentine Lakes, to which he added sketches of Gulquac, Milpagos and Milnagek Lakes, taken apparently from Hind's descriptions. Mr. McInnes' results are given briefly in the Report of Progress of the Geological Survey for 1887, and are embodied in the Geological map of the region, by far the best map published up to the present time. In the same year, Mr. John V. Ellis visited Trowsers Lake, and published a popular account of his experiences in three articles in the St. John

* On this map see Note 29 earlier, page 239.

† St. John, 1864. Also in "Vacation Tourists," Vol. III. London, 1864.

‡ The Indians were of course mistaken when they told Gordon he was the first white man to reach Long Lake, for Garden had surveyed it in 1838.

§ A Preliminary Report on the Geology of New Brunswick, Fredericton, 1865.

‖ I am indebted to Mr. McInnes for a copy of his map, resulting from this survey, on a scale of one mile to an inch. For the lakes mentioned it forms the basis of the map accompanying this paper.

Globe, August 10th, and later. In 1893 a party of naturalists from the American Museum of Natural History, New York, led by Mr. John Rowley, spent six weeks at Trowsers Lake studying and collecting the mammals of the region. Their results were published by J. A. Allen in the Bulletin of the Museum, Vol. VI, 1894 (99–106, 359–364), and these papers embody not only a valuable contribution to the natural history of that region, but one of the most important contributions that have yet been made to the mammalogy of New Brunswick. There are scattered references to other results of this trip in one or two special papers on mammals; but I am informed that aside from these no account of this expedition has been published. In July, 1900, I spent three weeks upon these lakes in company with Mr. G. U. Hay; and for a part of the time we were accompanied by Mr. M. I. Furbish, of Attleboro Falls, Mass., and his guide. Such results as we were able to obtain are presented in part herewith, and others are to follow.* I believe this exhausts the list of recorded explorations and publications relating to these lakes.

Place Nomenclature.—There is no name in use for this group of lakes as a whole, and hence I have ventured to apply to them the ancient Maliseet name of the Tobique River, that is, *Negoot.*† The names *Trowsers*, *Long*, *Portage* and *Serpentine*, appear to have been first placed on maps by Garden in 1836-38, though doubtless some of them at least were in use before his time. All are descriptive and self-explanatory, *Trowsers*, of course, being shaped like the garment of that name. *Adder* was used by Garden, but I do not know its origin. *Blind* appears first on McInnes and is descriptive of its lack of inlet or outlet. The names of the smaller lakes, *Gray's*, *Merithew's*, *Costigan's*, *Ogilvie's*, are in use by guides and seem to be for local guides and trappers;‡ they now appear on a map for the first time. *Indian* and *Trout* are sufficiently descriptive. Certain names are of Indian origin: *Milnagek*, with the *g* hard, (lake of many islands); *Milpagos*

* We went in over the Trowsers Lake portage road, passed through the chain, exploring from the heads of the larger lakes, and descended the Serpentine. A popular account of the trip is being published by Mr. Hay in the *Educational Review*.

† Familiarized from *Nay-goot* or more properly *Nay-goo-oot* (from a distance called *Nay-goo-oot-cook*). Its meaning is unknown, but I suspect it is connected with *Nik-taak*, Forks, in reference to the repeated forking of the Right Hand Branch.

‡ For a list of these names and for other information, I am indebted to Mr. Geo. E. Armstrong, head guide, Perth Centre.

(lake of many arms or branches, which well describes it ;*) *Gulquac* (meaning unknown); *Skut*, (fire). Certain other Indian names are given in reversed italic upon the map, though none of them are now in use: *Belchesogamook*, Maliseet name for Trowsers Lake (*Belches* is the Indian pronunciation of breeches, *i. e.*, trowsers, and *agamook* is lake; evidently this is but a translation of the English name and is not aboriginal) ;† *Quasquispac*, Maliseet name for Long Lake (meaning unknown); *Nalaisk*, Maliseet name for the Serpentine (meaning unknown); *Paquopsk* Maliseet name for the Right Hand Branch (means rough river); *He-be-se-kel*, Maliseet name for Portage Lake Stream (meaning unknown).‡ *Seguaque-kesk* is from Mr. McInnes' manuscript map. The name *Britt* Brook is in common use by lumbermen and Indians, but I cannot find its origin. *Lhoks* was given by Gordon, as he tells us, for the Indian nickname of one of his companions. *Campbell* was evidently given by Garden in honor of the then governor of the province, but it is only a map name not in use locally; *Don* was also given by Garden (perhaps with the English river of that name in mind). Four names of lakes on the map are new, and have been given by me; two fine lakes with no special names, but known to the guides simply as the second and third Adder Lakes, have been named *Hind* and *McInnes* for the two geologists who have visited and described or mapped the region (*Garden* is already commemorated in a mountain beside Nictor Lake). An hitherto nameless pretty pond at the very head of the chain of lakes emptying into Trowsers, is named *Furbish* for Mr. M. I. Furbish of Attleboro Falls, Mass., my companion in the mapping of Island Lake and other explorations in the region. Another little nameless lake on the inlet of Long Lake is named *Tangent* Lake because of the remarkable way in which the stream just touches it on one side.

Description.—The Negoot region is remarkably uniform in its character. Everywhere one is impressed by the innumerable smoothly-rounded hills and ridges of moderate height, by the splendid living forest which completely covers them, by the number and beauty of the lakes, by the swiftness of the streams, by the abundance of big animals

* Hind says the name does not well describe it, but he could not have seen the whole lake, for it is an extremely appropriate name. See map.

† The name Pechayzo given to Gordon by Indians and taken by him for Long Lake, is evidently a form of this name.

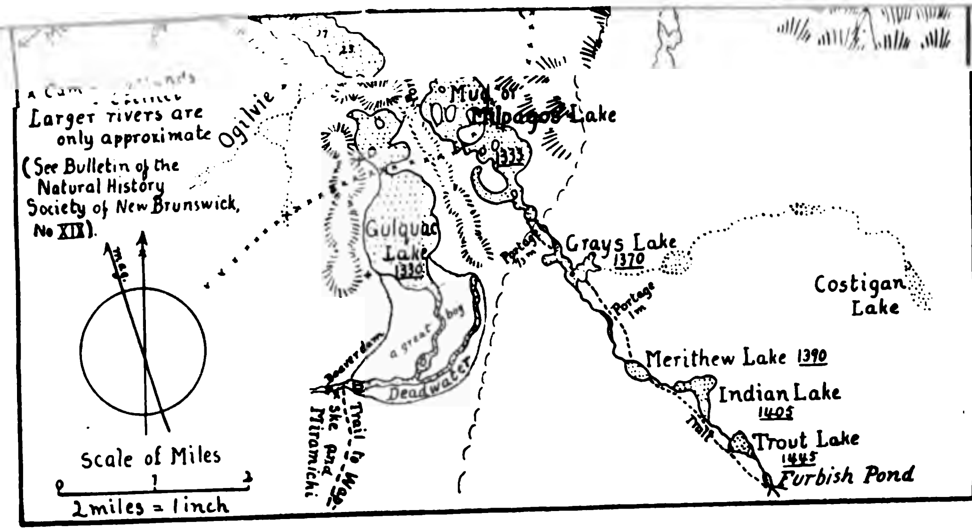
‡ Mamozekel is a corruption of Hebesekelsis, the Little Hebezekel.

moose, caribou, deer and beaver, by the all-pervading remoteness, wildness and primitiveness. The hills are never abrupt, nor have they bare tops nor sides; they are like great irregular green swells of the sea, suddenly fixed in stone. The forest is of the mixed sort, where the dark-green, spire-like tops of spruce and fir rise above the level of the brighter green of birch and maple. On the upper and smaller lakes, it has never been lumbered, and still is virgin and primeval. The lakes occupy valleys and hollows between the ridges, and show a considerable variety of character. Some (like Long Lake, Merithews and Indian Lakes) occupy deep and narrow valleys with rocky, wooded shores, while others (like Milpagos) lie in shallow basins, are greatly broken by points and islands, and are bordered by bogs; and there are all gradations between. The beauty of some of them is, however, marred by flooding, caused by dams, which gives their immediate shores a border of unsightly and well-nigh impenetrable dead and dying trees. The lake shores are but rarely of sand or gravel (and then only at the ends of the longest and most exposed reaches), but they are almost invariably of loose boulders, which both extend up upon the hills and out into the lakes in long morainic peninsulas or islands. Indeed, ledge rock is a great rarity, and the prevalence of the boulders is a very characteristic feature of the region, though these occur by no means of the size and conspicuousness familiar to us about the lakes in the southwestern part of the province.

Altitudes.—The only measurements of altitudes hitherto taken in this region were those of Mr. McInnes, made in 1886. He gives an elevation of 1,360 feet for Trowsers Lake, 1,370 for Long Lake, and 1,450 for Serpentine. During our stay we made as many observations as possible with a good aneroid. These were taken synchronously with the readings at Fredericton, and have since been corrected for weather by comparison with these, and for error of the instrument.* They have given the following results, above mean sea level. All calculations are conservative, leaning rather to too low than to too high levels:

Trowsers Lake, mean of 15 observations, 1,243 feet.
Mud or Milpagos Lake, 90 feet above Trowsers, hence 1,333 feet.

* For a full set of readings from the Fredericton Meteorological Station, I am indebted to Dr. Harrison, of the University of New Brunswick. For regulating and calculating the error of my aneroid, I have to thank Mr. Hutchinson, of the Meteorological Station at St. John.


Larger rivers are only approximate
(See Bulletin of the Natural History Society of New Brunswick, No XIX).
Ogilvie
Mud or Milpagos Lake
1333
Gulquac Lake
1330
a great bog
Deadwater
Beaverdam
Trail to Wapske and Miramichi
Grays Lake
1370
Portage 1m
Costigan Lake
Merithew Lake 1390
Indian Lake
1405
Trout Lake
1445
Furbish Pond
Trail
mag.
Scale of Miles
0
1
2
2 miles = 1 inch

Gulquac Lake. About the same as Milpagos, or a little less. A single measurement checked by comparison with Fredericton gave 1,328 feet, an excellent agreement,—say 1,330 feet.

Grays Lake, 20 feet above Milpagos, hence 1,353 feet. A single measurement checked by comparison with Fredericton gave 1,389 feet,—say 1,370 feet.

Merithews Lake, 20 feet above Grays, hence 1,390 feet.

Indian Lake, 15 feet above Merithews, hence 1,405 feet.

Trout Lake, 50 feet above Indian, hence 1,455 feet. A single measurement checked from Fredericton gave 1,438 feet,—say 1,445 feet.

Furbish Pond, 25 feet above Trout Lake, hence 1,470 feet.

Long Lake, mean of six measurements, 1,256 feet.

Island or Milnagek Lake, by direct aneroid measurement, 265 feet above Long, hence 1,521 feet. A direct measurement checked from Fredericton gave 1,495 feet. As the six measurements must be given more weight than the one of Milnagek, we can place the height at about 1,510 feet. This makes it the highest lake of any size in the Province of New Brunswick.

The crest of the ridge separating Long and Little Southwest Miramichi Lake is 475 feet above Long Lake, and hence 1,731 feet.

Third Lake. One measurement checked from Fredericton gave 1,248 feet. The fall from Long Lake must be at least 10 feet, hence the above must be about correct.

Crest of the ridge on the portage from Third Lake to First Beaver Pond, 260 feet over Third Lake, and hence 1,508 feet.

First Beaver Pond, 160 feet over Third Lake, hence 1,408 feet. A direct measurement checked from Fredericton gave 1,428 feet,—say 1,418 feet.

Second Beaver Pond is a few feet above Portage Lake, hence say 1,275 feet.

Portage Lake, mean of three measurements, 1,268 feet. Its relation with Adder Lake would seem to show that this is considerably too low.

Adder Lake stands considerably above Portage Lake,—say 50 feet, hence 1,323 feet. A measurement checked from Fredericton gave 1,327 feet. As this lake is, however, at least 10 feet higher than Serpentine, into which it flows, we must assign to it a greater height than the above figures signify,—say 1,350 feet.

Second Adder or Hind Lake, 100 feet above Adder, and hence 1,450 feet.

Third Adder or McInnes Lake, 15 feet over Hind Lake, hence 1,465 feet.

Serpentine Lake, mean of two measurements, 1,350 feet. The heights for Adder and Serpentine are inconsistent, as Adder flows into Serpentine by a swift broken stream. Hence we must lessen somewhat the height of Serpentine (despite the fact that McInnes makes it 1,460 feet), and we may call it 1,340 and Adder 1,350 feet.

Stillwater, mean of six measurements, 1,212 feet.

As this paper is in press, I have received Mr. Furbish's heights, obtained independently by him from his own aneroid, but checked by the same Fredericton readings used by me. He makes Trowsers as a mean of six readings,

1,229 feet; Milpagos, two readings, 1,272 feet; Gulquac, three readings, 1,331 feet (a remarkable agreement with my calculation); Long, five readings, 1,243 feet. The remainder of his measurements run much lower than mine.

Nalaisk Mountain, 2,529 feet. (See next note).

It will be observed that my measurements of all altitudes measured by Mr. McInnes differ from his by a little over 100 feet, mine being that much lower. This discrepancy I am entirely unable to explain.* I have, however, made so many measurements, and checked them so carefully by synchronous readings at Fredericton, and they are, as a whole (with the single exception of Adder Lake above), so consistent, that I have confidence in their essential correctness.

Lake Depths.—The depths of the various lakes as found by our soundings are shown upon the accompanying map. Some of them, such as Milpagos, are very shallow. The greatest depth we found was near the middle of Long Lake, 117 feet. Although this depth is not very considerable, it is the greatest yet recorded for any lake in New Brunswick.† Of course the lakes are shallowest near their upper ends where streams enter.

Facts of Interest about Particular Places.—The source of the Right Hand Branch of Tobique River is at the head of the middle of the three tiny brooks flowing into the upper end of Furbish Pond. This pond is small and shallow, fringed with bog and is a great haunt of moose. Trout Lake is an isosceles triangle, with the stream flowing from the middle of its base, so, if a more distinctive name were needed, it might well be called Triangle Lake. Its shores are entirely composed of small flat boulders of a crystalline shistose rock weathering very white, unlike any other we noticed on our trip. Indian Lake is very beautiful with its high-wooded shores, while Merithews Lake is a gem. Oval in shape, with mostly rocky shores, and with high hills on the immediate west, it is one of the prettiest smaller lakes of the province. Grays Lake is much like Milpagos. Milpagos is a very shallow lake, broken into many arms, and with reeds and other water plants growing all over it. It is a great haunt of moose. Gulquac Lake is one of the prettiest of the entire group, made so by its hills and ridges, of which a particularly fine one is on the west. Its level

* Mr. McInnes writes me that he made about thirty aneroid readings at the times of the Fredericton readings, by which they were afterwards checked.

† Mr. J. W. Bailey tells me, however, that he has obtained 165 feet in Glazier Lake, on the St. Francis, near the New Brunswick side.

is kept a foot or more higher than normal by a huge beaver dam across its outlet. This dam was described by Hind, and his description is still applicable. The southern end of the basin is filled by an immense bog through which meanders the deadwater stream. It is more frequented by moose than any place I have ever seen. In one day we counted nine about it, while Mr. Furbish on another day saw no less than fourteen. Trowsers Lake is attractive, though injured by the dead trees killed by the dam at its outlet. This dam holds the water some six feet above its normal level, so that for natural depth the figures on the map are six feet too high. The Twin Mountains on the east cannot be seen from most of the lakes, but only from near the Long Lake Portage. Blind Lake is very pretty with high wooded banks. It seems about twenty feet above Trowsers Lake. It is said to have no inlet nor outlet, but probably it has both through the great boulders of which its basin appears entirely to consist. Lhoks Lake is a beaver pond, at least in part. The Portage from Trousers Lake is low, and appears to follow some ancient communication between the two valleys. Long Lake is by far the most beautiful of all the larger lakes. It has no dam at the outlet and hence the shores are unmarred. Bold headlands are numerous, while the hills are everywhere fine and the views up and down particularly grand. It is one of the few lakes in the province containing togue, a fish which seems to occupy only deep lakes. Off to the southward is the great watershed ridge, nearly 500 feet high, separating these waters from the Miramichi system. Island or Milnagec Lake lies over 250 feet above Long Lake, into which it tumbles by a very pretty brook in a series of cascades. It is extremely beautiful, with its many wooded islands and splendid wooded ridges about it. It occupies a great hill basin apparently on a height of land between the Long and Trowsers Lake valleys. It is wild and untouched in any visible way by the hand of man. It is at the same time the highest and one of the most charming of New Brunswick lakes. Third Lake resembles Long, but Second is spoiled by a new dam. The beaver ponds on the portage road to Portage Lake, are very typical and show new dams. Portage Lake is also attractive, the more so from the new beaver dams and houses at its upper end. Adder Lake has the usual high wooded shores. Into it, at the western end there falls by a series of cascades, a large stream. A mile up this stream lies Hind Lake, about which

the game trails are more abundant than I have seen them elsewhere in New Brunswick. One can walk around the lake with ease on these well beaten paths. Fresh beaver dams and houses are abundant. A little further on lies McInnes' Lake, also the haunt of much game. Looking across it to the south-east, one can see the high watershed ridge, and beyond that Cow Mountain looms up. The forest about these lakes is more open than elsewhere, and here and there are some open spots where the huge dry boulders are covered simply with reindeer moss, constituting a sort of small barren. Serpentine Lake is, like most of the others of the chain, hill encompassed. The points, so characteristic of the lake, are largely of boulders; hence the shape of the lake as seen on the map is not the true shape of the valley in which it lies, for the latter is much more regular.* Between most of the lakes are good portage paths, many of them well beaten, and probably used for ages. In some places, however, they have become confused by the lumber roads, and between Third Lake and Portage Lake the old trail has been partially abandoned, and the lumber roads are used instead.

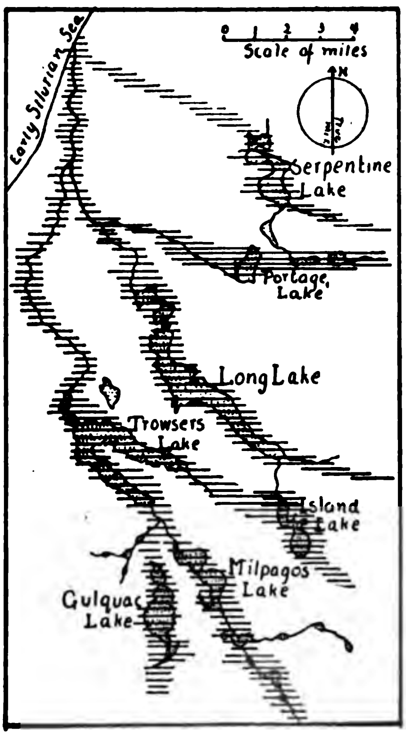
Geology.—All that is known of this subject is to be found in the reports of Hind, and Bailey and McInnes, already mentioned. We have nothing new to offer.

Natural History.—All that has been published is the work of Allen, already referred to. The botany will be treated from a floristic point of view by Mr. Hay. My own studies were entirely upon the plant-formations, an ecological study, upon which a report will later be offered.

The Origin of the Lakes.—An inquiry into their origin makes it at once clear that we are here dealing with a very typical group of Glacial lakes. A visit to the region, and even the inspection of the map, crude as it is, shows that the lakes lie in a series of nearly parallel or somewhat radiating valleys, into and across which masses of Glacial drift have been thrown. In some cases the drift formed a dam across the valley, leaving a part of it of its original depth, or nearly, as in the case of Long Lake, whose depth is thus explained. In other cases the valley has been well filled with the drift which, thrown down with great irregularity, has produced a shallow lake

*The dam at the outlet of this lake held the water up about two feet, and hence for natural depths that amount is to be deducted from the figures on the map.

broken by points and islands. An extremely good example of this type of lake is Milpagos, whose many points and islands are moraines. Indeed it would be difficult to find in the province two finer examples of the two extreme forms of Glacial lakes than Long and Milpagos. Of course there are all gradations between these types. Of morainic origin are the many islands in Island or Milnagek Lake, which have their long axes parallel and nearly northwest and southeast. The great peninsula dividing Trowsers Lake into two "legs" is largely, if not entirely, a huge moraine. The valley in which this shallow lake lies is evidently largely drift-filled.



So much for the origin of the present lakes. The question now arises as to the origin of the valleys in which they lie. Of these there are several, partially parallel, but with a tendency to a radiation southward and convergence northward, a fact brought out with the greatest clearness when we shade them along their approximate axes, as has been done in the accompanying map. Very distinct is the valley occupied by the chain of lakes from Furbish Pond to Trowsers Lake, and this is the longest and perhaps the main valley, into which the others fall. Gulquac occupies a parallel valley, and perhaps emptied by some of the Ogilvie Lakes into Trowsers. Possibly Island Lake belongs really to a smaller valley of the eastern leg of Trowsers, and its fall into Long Lake may be post-Glacial. Particularly distinct is also the Long Lake valley, and the depth of Long Lake shows how deep the valleys may have been.* Another is the Portage-Hind-

* Possibly this depth is due in part to the gouging action of glaciers, but damming of a deep valley seems more probable.

McInnes Lakes valley, which emptied probably in pre-Glacial times along Britt Brook. The Serpentine seems to occupy still another distinct valley. Since the Serpentine River has throughout its course the appearance of a comparatively new river, it is likely there was an older outlet of the lake valley into the Right Hand Branch. Possibly this occurred through the valley now occupied by the brook flowing into the extreme northern end of the Serpentine Lake, for I find on McInnes' large-scale map this legend on this brook "heads very near the left hand branch of Britt Brook." There appear then to be here three or four main valleys, with two or three minor ones, all converging northwards and uniting at different points, until, somewhere north of the Forks of the Right Hand Branch and the River Don, all have united into a single trunk valley. (See the map). I have not seen the valleys of these rivers below the lakes, but it is probable that, allowing for changes caused by Glacial drift, they show the characteristics of ancient valleys. Certainly this is the case with the portions occupied by the lakes, and above them. They all have a marked northern slope, and the smooth rounding of the hard pre-Cambrian rocks of their walls indicates great age. A very high watershed ridge separates them all from Miramichi waters. Gathering these facts together, then, we must conclude that these valleys are branches of an ancient river draining these highlands northward from very ancient times. Looking now at the geological map, we notice that the Silurian rocks of the great northern plateau approach near to the Forks of the Right Hand Branch and River Don, that is, near where all the valleys converge. It is altogether probable, then, that this ancient river is pre-Silurian, and in the Silurian period poured its waters from these highlands (of course then far above their present level) northward into the great Silurian sea, which occupied all the northern part of the province. Later, as the land arose, the present main Tobique River was formed by its drainage, and of course it received also the waters of our ancient valleys, which helped to make it, and swung them with it to the southwest. The valleys of these lakes, then, are pre-Silurian and much older than the main Tobique, and are among the most ancient in New Brunswick. The great height of the ridge separating them from the Miramichi system, and the evenness of the pitch northward of the valleys, would indicate that they are homogeneous streams, and have never captured the waters of other rivers, nor had

their own waters captured by any others, except, of course, by the main Tobique.

Economics.—A question of great importance now naturally arises as to the economic value of this Negoot region, a question which not only concerns members of this Society as citizens of New Brunswick, but as men of science, for the advancement of science is inseparably dependent upon the increase of material wealth. It is entirely and absolutely useless for the most part for agriculture, and it has shown few or no evidences of mineral wealth. There is, however, one service to which it is grandly adapted, namely, the growing of useful trees. It bears now one of the finest forests of New Brunswick, one which has never been burnt and which has not, as yet, been injured by injudicious lumbering. It is naturally one of the regions which the province would set aside for a forest reserve, to be managed upon good forestry principles, when the time arrives for such action, as it soon must. But unfortunately the greater part of it, all the part west of the county line and including all the Trowsers Lake and Long Lake systems, has passed out of the possession of the province. It is a part of the grant to the New Brunswick Railway Company, and is now the property of that corporation. Doubtless, however, mutually satisfactory arrangements between the province and the company for its management will be made in the future.

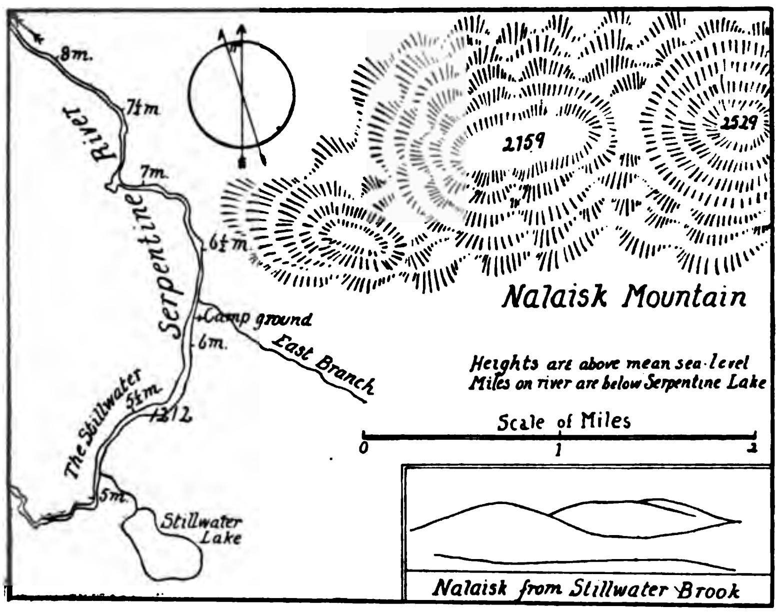
A second use of the region is as a game preserve. Its remoteness and difficulty of access have aided the laws to preserve the larger animals, with the result that these are now very abundant, as mentioned earlier in this paper. The waters also abound in large trout and Long Lake with togue. A continuance and extension of the present wise policy as to game preservation will make this region increasingly valuable as an attraction to sportsmen of wealth.

A third use of the region is as a camping and recreation ground for vigorous New Brunswick youth,—for its manly young men who love outdoor sport and nature, and the free, ennobling and health-giving life of the woods. There is no grander sport than the management of one's own canoe on these swift rivers and charming lakes, no greater feeling of triumph over obstacles than one has when, unguided and unaided, he makes his way from lake to lake, and river to river, seeking out his own paths, transporting his own outfit, exercising his own powers of generalship and ingenuity. There can be no greater

joy than the penetration on glorious summer days to the summits of great hills that have rarely indeed felt the foot of man, or into lakes unmapped and unsuspected. The influences of such life are altogether good, and the young men of New Brunswick enjoy exceptional opportunities for it. Why do they not rise oftener to their great privileges?

40.—On the Height of Nalaisk Mountain on the Serpentine.

As one descends the Serpentine River from the lake, he sees, as he nears the Stillwater, a splendid double mountain towering before him, which impresses him as not only the highest on the river,



but as one of the highest in the province. It stands east of the angle where the river first makes its great bend to the westward (see the accompanying map) and is shown without name, but not in quite the correct location, upon the Geological Survey map. In July last, upon a very favorable day, I was able to measure its height. It consists of two peaks; the western and lower is nearly bare and rocky, and commands one of the grandest hill and forest views in New Brunswick, while the eastern and higher is densely wooded. The western peak is

by direct aneroid measurement 947 feet above the Stillwater, which by a mean of six observations, made synchronous with and corrected by readings at Fredericton, is 1,212 feet above mean sea-level. The western peak is therefore 2,159 feet above the sea. But the eastern peak is by direct aneroid measurement 370 feet above the western, and hence 2,529 feet above the sea, thus making Nalaisk one of the greater mountains of the province. All of my measurements are conservative throughout, and below rather than above actual height; hence Nalaisk certainly belongs to the honorary 2,500 foot class of New Brunswick mountains.*

Some five miles away, bearing N. 22° east magnetic (from Bald Head N. 75° east magnetic) is another great mountain far back from the river, and seemingly higher than Nalaisk.

The name Nalaisk perpetuates the ancient Indian name of the Serpentine. It is unquestionably the mountain referred to by Lugrin, in an article in the St. John *Globe*, Feb. 10, 1886, when he states, after referring to Bald (Sagamook) Mountain and others, "the Indians say that Noll-isk Mountain on the Serpentine branch is higher than either of them."

41.—On a Remarkable Crateriform Spring near the Negoot Lakes.

Some four miles south-east of Long Lake, of the Negoot chain, and nearly on the county line, is a shallow valley with a tiny stream emptying towards the Little South-west Miramichi Lake. On the flat bottom of the valley, near the stream and amongst a dense growth of the usual hardwood swamp trees, lies a beautiful spring, very clear and very cold. It is nearly circular, and some two or three feet across and over a foot deep, and is especially peculiar in this, that its water surface stands a foot or more above the general level of the ground, held up to that height by a symmetrical wall forming a regular basin, as a lake may be held in the crater of a volcano. This wall was

* This class includes only Sagamook, Carleton, Big Bald, Nalaisk, that have been measured; but unquestionably there are very many others still unmeasured in less accessible places. Perhaps Cow Mountain belongs in the series, though Mr. W. B. Hoyt, of Andover, informs me that he has measured it by aneroid (unchecked for weather) and partly thus and partly by triangulation, has made it 2400 feet. Mr. Hoyt sends me a number of aneroid measurements made in that vicinity, but as they are unconnected from any fixed base, they can be but rough approximations.

evidently built by the spring itself. It seemed to consist chiefly, if not wholly, of vegetable matter, including many fine interlacing roots, possibly those of the neighboring trees attracted to this position by their hydrotropism. Unfortunately, conditions at the time of our visit (in July last) did not allow us to make a careful examination. The guide accompanying Mr. M. I. Furbish, my companion at the time, stated that he had seen somewhat similar, though much less perfect, examples in the hardwood regions in Maine. I do not myself recall having seen anything like it elsewhere.

42.—On a Strange Position for a Peat-bog.

In the angle between the Main Tobique River and its Right-hand Branch, some five miles back from both, rises Bald Head, in many respects the most striking, easily-recognized and mountain-like mountain in New Brunswick. It rises perfectly abruptly some thousand feet above a flat basin, and its steep bare top is a conspicuous and unmistakeable object from every direction. It is locally reputed to be simply a heap of loose stones, which well describes the impression it makes upon one, but the description is not correct, for the top is of ledge rock. The southern slope is inaccessible, but the northern is easy to climb, though it consists of large, loose, angular felsite boulders at as steep a slope as they can rest. This slope, measured by a protractor on one of Mr. Hay's photographs, is 30°; but, owing to the distortion produced by the camera, it must be considerably greater. Upon this northern slope, resting upon the loose rocks, lie several small living sphagnum bogs. It is a sight calculated to make any botanist rub his eyes and wonder if much study hath not made him mad. These bogs are from about half an acre in extent down to a few square yards. At their upper margins they consist of the ordinary dry turf formed by the roots of trees, etc., not infrequent over rocky places, but downwards this passes gradually over into sphagnum bog, bearing Kalmia, Ledum, dwarfed spruces, and the other characteristic raised-bog (Hockmoor) vegetation. The bog reaches its greatest perfection at the lower margin, where the red sphagnum occurs in dense rounded polsters, evidently with sufficient moisture for healthy

* The Geological Survey map makes it 1,866 feet above mean sea-level. In July, 1900 we made it by aneroid over 1,000 feet above the basin in which it stands, and 1,425 feet above the bridge at Riley Brook,

growth. Their aspect here is almost identically that of the raised bogs which have been described from other parts of New Brunswick.* At the lower margin they are most bog-like, some two feet thick, and they end downwards with an abrupt rounded edge. Evidently the water in them settles to the lower edge, promoting the more vigorous growth there, and causing them to grow down the slopes. Such bogs demand much pure water for their growth, and the question now arises as the source of supply in this case. Two explanations appear possible. First, the bogs may have formed when the whole slope was heavily forested (as the many blackened stumps show that it was until recently), and since then they have managed to soak in enough water from the rains to keep them growing, the northern abrupt slope of the mountain protecting them from great evaporation. In this case they would simply be the remnants, rapidly disappearing, of once extensive bogs. Against this view, however, is the fact that such bogs do not appear to grow upon forested felsite hills in this region. I have been upon a number of them and have never seen such bogs Moreover, even if they are such remnants, it does not explain the source of the water sufficient to keep such extensive bogs supplied, for rain alone could scarcely do it in such a perfectly drained situation. The other explanation is that there is some peculiarity in the structure of this mountain which produces the storage of water under the rocks in spots, allowing it to escape gradually after the manner of springs. But no trace of such a structure is to be seen. The subject is very puzzling.

43.—Evidences of the Sinking of the Coast of New Brunswick.

Several of our writers on recent geology, notably Gesner, Matthew and Chalmers, have given evidence to show that the New Brunswick coast is sinking at several points. The following facts are of interest in this connection:

In 1797 a very careful survey of Dochet Island was made by Thos. Wright, Surveyor-General of Prince Edward Island, in connection with the boundary controversies, and his map has recently been published.† One prominent and easily-recognized ledge has this

* Upon Raised Peat-Bogs in New Brunswick. Transactions of the Royal Society of Canada, iii, 1897, section iv, 131.

† Transactions of the Royal Society of Canada, v, 1899, section ii, 264.

legend: *High Ledge somewhat green at its top.* This green can, of course, only refer to vegetation, since the ledge is red. That ledge to-day bears not a trace of any vegetation, apparently because the sea now washes high enough to prevent it, though otherwise the situation is a favorable one for the lodgment of some plants. The evidence of ecology shows that vegetation tends, unless prevented by unfavorable outside influences, to increase, not to diminish, in such places.

Gesner states in one of his papers that the gateway of old Fort Monckton, once of course well-above sea level, was in his time washed by the sea. He must refer here to the approach of the sea against the Fort through the washing away of the coast rather than to an actual dipping of the ground level of the Fort beneath the sea level. The exact extent of the washing away of the coast at Fort Monckton since it was built is happily known. Two maps recently published* show the outline of the coast near the Fort when it was built, about 1751 (from a very careful survey made by the eminent French Engineer Franquet), and the outline in the year 1897. Comparison of the two shows that about thirty-five yards of the upland have been washed away on the north-east corner, and over double that amount on the south-east side. This washing away of the upland can only be explained by a marked sinking of the coast, though the amount of the sinking is not thereby determined.

* Op. cit. 289, 290.

ARTICLE VII.

PRELIMINARY LIST OF NEW BRUNSWICK FUNGI.

BY G. U. HAY.

No list of fungi of the province has been published since Professor Fowler prepared a short list, more than twenty years ago. It has been felt for some time by the members of this Society that a systematic attempt should be made to study the fungi of this province. The difficulty of preserving many of the species and the want of suitable text-books to assist in identifying specimens, have been obstacles. Several of our members who have been interested in this useful class of plants have promised their assistance. It is thought advisable to publish the following preliminary list, which embraces the collections made by the Misses Van Horne, at St. Andrews, and by the writer at Ingleside during the past two seasons. The list is a small one, and takes in for the greater part only a few of those popularly known as Mushrooms or Toadstools, Puffballs, etc. It is hoped, however, that the list, imperfect as it is, will serve to draw attention to this important class of plants, and lead to a closer study of them throughout the province.

Care has been taken to have this list correct. All critical species collected by the Misses VanHorne were submitted to Prof. Peck, State Botanist of New York, for his decision, while those collected by the writer have been identified by Prof. Farlow, of Harvard University.

No attempt has been made, except in two or three well-known instances, to separate the poisonous from the edible species. To give directions which shall enable anyone to distinguish harmless species from those that are injurious, is practically impossible, as certain edible species resemble closely those that are poisonous. It is better, therefore, in selecting for the table, to avoid all except those that have been pronounced upon by expert authorities. The caution given by a

writer on mushrooms and toadstools should be remembered: "Any toad-stool with white or lemon-yellow gills, casting white spores when laid—gills downward—upon a sheet of paper, having remnants of a fugitive skin in the shape of scabs or warts upon the upper surface of its cap, with a veil or ring, or remnants or stains of one, having at the base of its stem—in the ground—a loose, skin-like sheath surrounding it, or remnants of one, should never be eaten until the collector is thoroughly conversant with the technicalities of every such species, or has been taught by one whose authority is well known, that it is a harmless species. . . . Safety lies in the strict observance of two rules: Never eat a toadstool found in the woods or shady places, believing it to be the common mushroom. Never eat a white or yellow-gilled toad-stool in the same belief. The common mushroom does not grow in the woods, and its gills are at first pink, then purplish-brown or black."—*McIlvaine.*

The advice, "Have nothing to do with any except those that are well known," is safe. But there is abundance of good wholesome food going to waste every year for want of a little knowledge about the common species of fungi, known as mushrooms or toadstools, that grow in our fields and woods. Should not our Society make an attempt to help people to secure some desirable information on this point?

A recent book on the subject—Studies of American Fungi: Mushrooms, Edible, Poisonous, etc., by Prof. Atkinson, of Cornell University, price $3.00, will be found attractive to the beginner and useful in determining the more common species.

HYMENOMYCETES.

AGARICACEÆ.

AMANITA MUSCARIUS, Linn. Poisonous. In woods, chiefly birch and fir. Common.

AMANITOPSIS VAGINATA, Bull. Var. *fulva*, Schaeff. Yellowish.
Var. *livida*, Pers. Leaden brown.

CLITOCYBE INFUNDIBULIFORMIS, Schaeff. Plentiful after rains.

C. OCHROPURPUREA, Berk. On clayey soil in woodlands.

COLLYBIA BUTYRACEA, Bull. Solitary and in clusters under coniferous trees.

C. ACERVATA, Fr. In clusters on decaying wood and among fallen leaves in woods.

PLEUROTUS PORRIGENS, Pers. Wholly shining white. On stumps, chiefly pine.

P. SEROTINUS, Fr. Dead trunks of deciduous trees.
OMPHALIA CAMPANELLA, Batsch. Debris of coniferous trees.
HYGROPHORUS MINUATUS, Fr. In open places.
H. EBURNEUS, Bull. Wholly shining white. Woods and pastures.
H. ERUBESCENS, Fr. In pine woods.
LACTARIUS DELICIOSUS, Fr. In woods.
L. PIPERATUS, Fr. In mixed woods.
RUSSULA HETEROPHYLLA, Fr. In woods.
R. EMETICA, Fr. In woods and open grounds.
R. AURATA, Fr. Cap brightly colored. In woods.
R. ALUTACEA, Fr. In mixed woods.
CANTHARELLUS CIBARIUS, Fr. Open woods and grassy places.
C. AURANTIACUS, Fr. Orange-yellow. On ground and very rotten logs.
MARASMIUS OREADES, Fr. Growing in circles or rows in lawns and pastures.
LENTINUS LEPIDEUS, FR. On pine and other timbers.
PANUS STIPTICUS, Fr. Gregarious on stumps.
TROGIA CRISPA, Fr. On wood.
CLITOPILUS ORCELLA, Bull. In pastures and open places in wet weather.
CLAUDOPUS NIDULANS, Pers. On decaying wood in autumn. Not common.
CORTINARIUS VIOLACEUS, Fr. Gills, stem and cap violet colored when young.
C. ARMILLATUS, Fr. In moist woods.
C. CINNAMOMEUS, Fr., var. *semi-sanguineus*, Fr.
AGARICUS CAMPESTER, Linn. The common Mushroom. Pastures and open places.
A. SILVICOLA, Vitt. Woods, copses, or along their borders. Edible, but the poisonous Amanita may easily be mistaken for it.
COPRINUS ATRAMENTARIUS (Bull.), Fr. Growing singly or in clusters in rich soil by waysides.

POLYPORACEÆ.

BOLETUS PIPERATUS, Bull. Woods and open places. Common and variable.
B. EDULIS, Bull. Woods and open places.
B. LURIDUS, Schaeff. In moist woods.
B. VERSIPELLIS, Fr. Woods and open places.
B. SCABER, Fr. Appearing through summer and autumn.
B. CHROMAPES, Frost. Woods.
B. CLINTONIANUS, Peck. Mossy or grassy ground in woods or open places.
B. SUBTOMENTOSUS, L. Common and variable.
B. BOVINUS, Linn. Pine woods.
B. FLAVUS, With. Apparently rare.
POLYPORUS PICIPES, Fr. On trunks, especially willow.
P. BETULINUS, Fr. On living and dead birch.
P. ELEGANS, Fr. On trunks, chiefly birch.
P. RADIATUS, Fr. Very much imbricated, on hazel, alder, etc.
P. FOMENTARIUS, Fr. On trunks. Common.

P. VERSICOLOR, Fr. On dead wood. Exceedingly common.
P. FUMOSUS, Fr. On old stumps. Common.
P. PERENNIS, Fr. On the ground and stumps. Common.
P. LUCIDUS, Fr. On and about stumps. Summer.
POLYSTICTUS ABIETINUS, Fr. On fir. Common.

HYDNACEÆ.

HYDNUM IMBRICATUM, Linn. In pine and mixed woods.
H. RUFESCENS, Pers. "The Hedgehog Mushroom." Edible.
H. COMPACTUM, Pers. In fir woods and on heaths. Rare.

CLAVARIACEÆ.

CLAVARIA AMETHYSTINA, Bull. A handsome species. Violet color. Open woods and grassy places.
C. FASTIGIATA, Linn. In grassy places.
C. CORALLOIDES, Linn. In shady woods.
C. CRISTATA, Pers. Common in woods.
C. AUREA, Schaeff. "Occurs after heavy rains."—McIlvaine.
C. FORMOSA, Pers. Growing in large tufts.

TREMELLACEÆ.

TREMELLA MESENTERICA, Retz. Bright orange. An apparent exudation from sticks, branches, etc.

GASTROMYCETES.

LYCOPERDON PYRIFORME, Schaeff. Pear-shaped puff-ball. In dense clusters. Common.
L. GEMMATUM, Batsch. Gemmed puff-ball. Growing on ground and rotten trunks in woods.
SCLERODERMA VULGARE, Fr. Common. Under trees.

HELVELLACEÆ.

MITRULA VITELLINA, Sacc. Small. Very bright yellow. Gregarious. Delicate flavor.

APPENDIX.

PRESIDENT'S ADDRESS.

THE OUTLOOK OF OUR SOCIETY.

BY G. U. HAY.

(Read at the Annual Meeting, January 16, 1900.)

After a four years' term of office as president, it is fitting, in giving place to my successor, to pass in review the work of our Society, to see if we are making progress, and to note whether that progress is substantial and serves to interest the whole community in the objects which we seek to further. In handing over the responsibilities as well as the pleasures of leadership, it is a source of the deepest gratification to acknowledge the cordial and diligent support you have given to me as president, and to ask for that same hearty co-operation of effort for my successor. While our members are few, and the number of our active workers still fewer, it is a cause for congratulation to note the unanimity with which every department of work is earnestly taken up and pushed forward from year to year. If differences of opinion have arisen, they have not for a single moment been allowed to interfere with the harmonious and useful work which the society is endeavoring to accomplish. Indeed, it must be that many of our members are called upon to make personal sacrifices in so unselfishly giving their time and abilities in furthering objects which have become very dear to us, and which, taken collectively, must be of some considerable material advantage to this province.

In a society such as ours, there are two distinct objects which should be constantly kept in view,—first, to stimulate by papers, discussions and by social intercourse an interest in natural history, and to educate and direct public interest therein; second, to carry on original research, so that not only our own people but the whole

world, may have some intelligent conception of the natural history and resources of New Brunswick. Both these objects are closely related; both are important. Our annual Bulletin, which contains a report of progress, shows that we do not content ourselves with lectures merely, and that our museum is not solely for the instruction of our members, the public generally, or children from the schools. Our bulletin sends forth a message every year to the scientific students of every country in the world where research is going on, informing them what the keen vision and working spirit of our members is accomplishing. The scientific visitor from abroad need not be in our museum many minutes before he finds out which we place most value upon—the products of other countries or the products of our own. By these tokens we should always be estimated. If we would continue to be known as a live society, we must continue to add from our province new material for scientific workers to draw new conclusions from, and to think about; not merely to turn over and re-discuss the facts of science that are already known. And if there is one thing that I would strive to impress on you more than another this evening, it is to urge you to fresh efforts along the line of original investigation. We have accomplished much. There is much more to be accomplished. We need more workers, it is true. But when we think that everywhere the work of the scientific explorer —that initial work that must be done in all countries such as ours— has been done by a few earnest investigators, we should take heart and each one press on in the special work he can do best. This involves sacrifice, for all of us are engaged in other affairs, and this extra duty that is undertaken voluntarily must be accomplished while others are taking rest or finding relief from their regular work in social recreation and pleasures. But there is a reward about it even in the life of self-denial that it entails,—much more, too, in the joy that there is in making discoveries that will benefit the world. I realized this a few months ago when I stood beside the chair of Sir Wm. Dawson in the twilight of a summer afternoon and heard him speak of some of the triumphs and hardships of a life that was just drawing to a close. He has since passed away, full of honors that come from continued effort, earnest self-sacrifice on behalf of science, and a diligent spirit. We delight to revere his memory for

these qualities,—incentives to every worker, no matter how limited may be his field of enquiry. Shall we not profit by his example? feeling that in the interest he always took in our society, he saw in it the evidence of a live spirit of research, and that bent for original investigation which characterized his own work.

It may be well to glance—and I shall do it very briefly—at some of the results of our investigations of recent years. It is well to pass in review occasionally the results of our work. It is a stimulus to increased effort in the future, because if we glance at present work alone we are apt to be discouraged at the small results accomplished in one season.

In geology Dr. Matthew has narrowed his work to the almost exclusive study of the fossil remains found in the slate beds that underlie the city of St. John. The results, published from time to time in our Bulletin, in the Proceedings of the Royal Society, and elsewhere, have attracted the attention of specialists throughout the world, the thoroughness and importance of the work being attested to by the large number of new species which have been added to science as a result of his investigations. This chapter of our geological history, when it comes to be written, will furnish a striking illustration of persistent and patient enquiry on the part of one of our members.

In botany scarcely a year has elapsed during the past twenty years in which some additions have not been made to the list of plants of New Brunswick. Many new areas have been examined and notes made of their agricultural capabilities, and of the species of plants found there. A new and revised edition of our flowering plants is greatly needed, and it is hoped that this will be prepared very soon. It is a sign of progress, also, to note that more attention is being given to the habits of plants, and how they adapt themselves to conditions of climate, soil, etc. A great impetus has been given in this direction by the publication of Prof. Ganong's papers on ecology and kindred subjects. Another indication of progress is seen in the beginning that has been made to study the flowerless plants of the province, especially the mosses, by Mr. John Moser, and the interesting list of fungi furnished to the Society by the Misses Van Horne and others. When one sees valuable food material such as exists in mushrooms, yearly going to waste for want of a better knowledge of

them; when one sees destructive fungi and vile weeds causing the loss of valuable crops, he could wish that the intelligent study of plants were pursued by hundreds.

* * * * * *

A few years ago we knew little or nothing of the insects of our province, or what species were found here; and there were few types in our museum that would help a student. Now we have some hundreds of species attesting to the activity and intelligent study given by Mr. McIntosh and his assistants to this important department. When we think how useful it is, not only to science generally, but to our agricultural industries especially, to have a minute and accurate knowledge of insects, particularly those that are beneficial or injurious to our agricultural interests, we cannot emphasize too much the importance of the work that is being done in this direction.

And here I may mention what our society has been aiming to do in its elementary work during the past few years, in throwing open its museum to the public, especially to the children of the public schools, and in giving elementary and laboratory instruction to all who choose to attend. We cannot estimate this work too highly, nor be unwilling to make some sacrifices to maintain it, even though popular interest is not fully aroused to take advantage of it. It will be aroused if we persistently keep at the work of elementary instruction, for in that, to a great extent, our future success is largely bound up. It is in interesting young people, especially in our Society and its objects, that we must depend for an increase of our membership; and in carrying on our work when those who are now our active members shall lay down the burden.

And while I am speaking of our elementary work, I should refer to the interest taken in our regular monthly meetings and the subjects there discussed. Take, for example, the programme of our regular work for this winter. It is full to overflowing on topics that are live and interesting, each one of which is important as illustrating the various phases of work in which the society is engaged. Prof. Ganong's continued interest is a source of strength to us. His notes from time to time on the physiography of New Brunswick and kindred topics are of very great value to our members as well as to the province.

The collection of birds in our museum, chiefly the results in past years of the work of Mr. Chamberlain and his assistants is of great interest to visitors. Mr. Leavitt is not only increasing this important collection, but by his lectures on bird life and structure, their protection and migration, he is laying a good foundation for the study of bird life and habits.

With the exception of birds and insects, our department of zoology is rather weak. Mr. Rowe and his fellow-workers have done some service in making us acquainted with a few native reptiles and amphibians; and I mention with pleasure the obligations we are under to Mr. W. A. Hickman, whose lectures and field work while with us have given an impetus in the study of zoology.

In the department of archæology a great interest has been aroused chiefly through the efforts of Dr. Matthew, Mr. S. W. Kain and Miss Jack. Our collection of native Indian relics is a very important one, and cannot fail, as the years advance, to become one of the most valuable portions of our museum.

We have seen during the past few years one branch of our society steadily growing in importance—the Ladies' Association. Owing to its exertions our library has been catalogued and improved, our museum thrown open to the public three times a week by engaging a competent assistant curator; our financial condition is improved, and a general air of refinement and homelikeness given to our surroundings.

There is a subject mentioned in the last two annual addresses to which I must make a passing reference in closing, and that is our pressing need of a new building, coupled with the equally pressing need of a stronger financial support for our society. We are doing a good work for the country; we are doing it in rooms so limited that we can no longer find suitable accommodation for our museum; and our finances are such that only the most rigid economy enables us to carry out and publish a meagre outline of what are the chief objects of this Society, namely, the carrying on original research in this province and publishing the results of it. With a new building and a larger income our society would enter upon a new era of usefulness.

REPORT OF THE COMMITTEE ON BOTANY.

The Committee on Botany report that during the past two seasons several districts of the province have been visited and notes taken of the flora, viz.: The country near the mouth of the Restigouche in the summer of 1899, visited by members of this Society and of the Summer School of Science; the Upper St. John and Aroostook rivers by Prof. Macoun and Mr. Hay in the fall of 1899; the South Tobique Lake region, including the Serpentine and Sisson Branch (branches of the Tobique), by Prof. Ganong and Mr. Hay in the summer of 1900. A list of the plants about Campbellton was made by Mr. Jas. Vroom, assisted by members of the Society and members of the Summer School. Some of the rarest or least known plants found there are named in the list appended.

The visit of that experienced botanist, Prof. Macoun, to the Upper St. John revealed the presence of quite a number of plants in localities where they have not hitherto been found in the province. Among other points which Messrs. Macoun and Hay tried to decide on their visit was, whether the fern *Scolopendrium vulgare*, reported from the vicinity of Woodstock some years ago by the late Peter Jack, Esq., of Halifax, is to be found growing wild there. After a careful search no traces of the plant could be found.

Prof. Ganong and Mr. Hay spent nearly four weeks among the lakes of the South Tobique basin during the month of July, 1900. The season was rather early to get the best results, but eight species and varieties of plants not hitherto known to the province were found. A descriptive account of the botanical features of the country has been prepared by Mr. Hay, which will be published at a later date. Other features of interest to botanists concerning this little known region are given by Prof. Ganong in his "Notes" of the trip, to be found in this number of the Bulletin.

In the list appended, the new species and varieties are printed in full faced type. The numbers correspond to Fowler's catalogue (Bulletin IV). The thanks of the Committee are due to Prof. Macoun and to Mr. M. L. Fernald, of Cambridge, Mass., for the determination of critical species.

3 Thalictrum occidentale, Gray. (T. dioicum of former lists).

4a Anemone parviflora, Michx. Aroostook Falls. Restigouche River.

6–7 A. riparia, Fernald. (A. Virginiana + A. cylindrica of former lists). Bull's Island, Woodstock.

43a Arabis perfoliata, Lam. Aroostook Falls.

66 Viola renifolia, Gray. Grand Falls.

69 V. canina, L., var. Muhlenbergii, Gray. (V. canina, L., var. sylvestris, Regel, of former lists). South Tobique Lakes.

170 Rubus idæus, L., var. strigosus, Maxim. (Rubus strigosus, Michx., of former lists).

183 Potentilla Monspeliensis, L. (P. Norvegica, L., of former lists). South Tobique Lakes.

194 Rosa blanda, Ait. South Tobique Lakes.

200a Amelanchier oligocarpa, R. and S. (Amelanchier Canadensis, Torr. and Gray., var. oligocarpa, Gray, of former lists).

265 Viburnum pauciflorum, Pylaie. South Tobique Lakes.

307 Aster Lindleyanus, Torr. and Gray. Aroostook Falls.

308a Aster Tradescanti, L. Meduxnakik Creek, Woodstock.

323 Antennaria Canadensis, Greene. (Antennaria plantaginifolia, Hook., *in part* of former lists). South Tobique Lakes.

329a **Ambrosia trifida,** L. Ingleside.

346 Artemisia Canadensis, Michx. (A. caudata, Michx., of previous lists). Bull's Island, Woodstock.

352 Arnica Chamissonis, Less. Sisson Gorge.

356 Arctium Lappa, L., var. **minus,** Gray. Near Campbellton.

363 Cichorium Intybus, L. Campbellton. Ingleside.

363a Hieracium aurantiacum, L. Near Campbellton.

363b H. præaltum, Vill. Very common about the lower Restigouche and Upsalquitch. A pest to farmers.

416 Primula Mistassinica, Michx. Restigouche River. Aroostook Falls.

423 Anagallis arvensis, L. Ingleside.

440 Symphytum officinale, L. Campbellton.

453 Hyoscyamus niger, L. Campbellton.

505a **Plantago Rugelii,** Decaisne. Ingleside.

535 Rumex Patientia, L. (R. pratensis, of former lists). Ingleside.

547a E. maculata, L. Railway track near Campbellton. Railway track along Aroostook River.

548 E. Helioscopia, L. Campbellton.

583 Salix nigra, Marsh. Ingleside.

591a **Ceratophyllum demersum,** L. Eel River, mouth of Chase Brook.

611 Listera cordata, R. Br. South Tobique Lakes.

617a Goodyera Menziesii, Lindl. Near Squaw Cap Mountain.

660 Zygadenus elegans, Pursh. (Zygadenus glaucus, Nutt., of former lists). Campbellton.

701a Potamogeton heterophyllus, Schreb. Aroostook River.

707 Potamogeton pusillus, L. Chase Creek, near Woodstock.

713 Naias flexilis, Rostk. Chase Creek, near Woodstock.

724 Scirpus cæspitosus, L. Aroostook River.

732*a* **S. atrocinctus,** Fernald, var. **brachypodus,** Fernald. South Tobique Lakes.

753*a* Carex canescens, L., var. **vulgaris,** Bailey. South Tobique Lakes.

754*a* **Carex trisperma,** Dewey. South Tobique Lakes.

756 C. sterilis, Willd. South Tobique Lakes.

756*a* C. sterilis, Willd., var. **excelsior,** Bailey. South Tobique Lakes.

756*b* **Carex interior,** Bailey. Ingleside.

758 C. scoparia, Schk., var. minor, Boott. South Tobique Lakes.

765 C. aquatilis, Wahl. South Tobique Lakes.

766 C. torta, Boot. South Tobique Lakes.

768 C. stricta, Lam. South Tobique Lakes.

768*a* C. stricta, Lam., var. **curtissima,** Peck. South Tobique Lakes.

769 C. lenticularis, Michx. South Tobique Lakes.

773 C. crinita, Lam., var. gynandra, Schw. and Torr. (C. gynandra, Schw., of former lists). South Tobique Lakes.

775 C. Magellanica, Lam. (C. irrigua, Smith, of former lists). South Tobique Lakes.

777*a* C. atrata, L., var. ovata, Boott. South Tobique Lakes.

784*a* Carex eburnea, Boott. Grand Falls.

799 C. filiformis, L. South Tobique Lakes.

809 C. rostrata, Stokes. South Tobique Lakes.

809*a* C. rostrata, Stokes, var. **ambigens,** Fernald. South Tobique Lakes. "Very slender, 3 to 5 dm. high, culms barely 1 mm. in diameter below the spikes: leaves 2 to 5 mm. wide: staminate spikes 1 or 2; pistillate 1 to 3, globose or short-oblong, 1 to 2.5 cm. long: perigynium as in the species.—NEW BRUNSWICK, South Tobique Lakes, July 18, 1900 (*G. U. Hay*, no. 41): MAINE, sandy shore of St. John River, St. Francis, June 18, 1898 (*M. L. Fernald*, nos. 2076, 2077). Habitally resembling *C. vesicaria*, but with the stiffer habit, the spongy culms smooth and bluntly angled above, the nodulose leaves, and the perigynia of *C. rostrata*."—*M. L. Fernald in letter.*

815 Carex oligosperma, Michx. South Tobique Lakes.

815*a* **C. vesicaria,** L., var. **jejuna,** Fernald. South Tobique Lakes. "Smaller and more slender than the species; leaves mostly 3 mm. wide: pistillate spikes thinner, 5 to 8 mm. thick: perigynium turgid, roundish-ovate, 4 or 5 mm. long, abruptly tapering to the beak.—QUEBEC, Lakes Edward and St. John, August, 1896 (*E. Brainerd*): NEW BRUNSWICK, South Tobique Lakes, July 18, 1900 (*G. U. Hay*, no. 57): MAINE, St. Francis, June 18, 1898 (*M. L. Fernald*, no. 2075); Madawaska Lake, August 2, 1900 (*E. F. Williams*): NEW HAMPSHIRE, North Conway, August 27, 1855 (*Wm. Boott*); Echo Lake, North Conway, June 8, 1878, near Gate of the Notch, July 7, 1878,

and between Bethlehem and Fabyans, July 5, 1879 (*E. & C. E. Faxon*): VERMONT, Island Pond, July 4, 1854 (*Wm. Boott*); Gardner's Island, Lake Champlain, June 26, 1877 (*C. G. Pringle*); East Wallingford and Bloomfield, 1899 (*W. W. Eggleston*, nos. 1659, 1667): MASSACHUSETTS, Framingham, July 7, 1897 (*E. C. Smith*, no. 654): RHODE ISLAND, banks of Seekonk River, June 15, 24, 1867 (*S. T. Olney*): CONNECTICUT, Hartford, June, 1879 (*C. Wright*): NEW YORK, Sand Lake (*C. H. Peck* ; Raquette Falls, July 11, 1899 (Rowlee, Wiegand & Hastings): ONTARIO, Nipigon River, July 22, 1884 (*J. Macoun*)."—*M. L. Fernald in letter.*

824*a* Setaria Italica, Kunth. Bank of river, Woodstock.
833 Hierochloe borealis, Roem. and Schultes. Aroostook River.
842 Brachyelytrum aristatum, Beauv. Bull's Island, Woodstock.
843*b* **Sporobolus vaginæflorus,** Vasey. Aroostook River.
843*c* S. depauperatus, Vasey. Aroostook Falls.
847 Agrostis alba, L. Aroostook River.
867 Graphephorum melicoides, Beauv. Aroostook River.
889*a* Elymus Canadensis, L., var. **glaucifolius,** Gray. Aroostook River.
876*a* **Glyceria borealis,** F. W. Batchelder. South Tobique Lakes.
896*a* Equisetum variegatum, Schleicher. Aroostook Falls.
899 Adiantum pedatum, L. Islands in Restigouche River.
901 Pellæa gracilis, Hook. Restigouche River.
902 Asplenium viride, Hudson. Morrissey's Rock.
907*a* Phegopteris calcarea, Fee. Squaw Cap Mountain.
910 Aspidium fragrans, Swartz. Sisson Branch. Squaw Cap Mountain.
914 A. Filix-mas, Swartz. Bull's Island, Woodstock.
923 Woodsia hyperborea, R. Br. Morrissey's Brook. Restigouche River. Aroostook Falls.
923 Woodsia glabella, R. Br. Restigouche River. Aroostook Falls. Sisson gorge.
936 Lycopodium inundatum, L. South Tobique Lakes.
941*a* **Selaginella selaginoides,** L. Grand Falls.

Mr. Fernald, of the Botanic Gardens, Cambridge, Mass., writes (February 1st, 1901), that he collected several plants last fall, either at Van Buren, on the St. John, or at Fort Fairfield, on the Aroostook, which our botanists should find near at hand in New Brunswick territory, such as *Matricaria discoidea*, *Gentiana Amarella*, var. *humifusa*, *Salix adenophylla*, *S. glaucophylla*, *Listera auriculata*, *Juncus Dudleyi*, *Lycopodium sitchense*, and *L. sabinæfolium.*

G. U. HAY,
Chairman Committee on Botany.

OBSERVATIONS IN WILD GARDEN, INGLESIDE, 1900.

BY G. U. HAY.

(Read November 6, 1900.)

The months of April and May, up to May 24th of this season, were very cold and backward, the rains and north-easterly winds retarding vegetation. On my first visit to Ingleside, May 12th, the following plants were just beginning to bloom: Viola blanda, Erythronium Americanum, Anemone nemorosa, Fragaria Virginiana, and these only in places fully exposed to the sun. Epigæa repens, Hepatica triloba and Acer rubrum were in full bloom.

May 24th (a warm, sunny day). Plants in full bloom: Taraxacum Dens-leonis, Fragaria Virginiana, Sanguinaria Canadensis, Claytonia Virginica, Houstonia cærulea, Erythronium Americanum. Just coming into bloom in places exposed to the sun: Viola cucullata, Viola canina, var. sylvestris. Amelanchier Canadensis, var. botryapium. Viburnum lantanoides, with the white marginal flowers expanding. The white birch, which is one of the first to come into leaf, and one of the last to lose its foliage in the fall, was unfolding its leaves under the influence of the bright sun and gentle winds of the day.

June 9th. Sunshine and frequent rains since May 24th produced that wonderful change which is so characteristic of our springs: In a few days' after weeks and months of weary waiting, plants seem all at once to burst into flower and leaf, each day producing a marked change in the face of nature.

Plants in full bloom: Trillium Erythrocarpum, T. erectum, T. cernuum (just out), Primula Mistassinaca, Cypripedium acaule) just beginning to bloom), Rhodora Canadensis, Cornus Canadensis.

June 14th. Cypripedium parviflorum, just opening its yellow flowers, as also Iris versicolor, Cratægus tomentosus; Cypripedium acaule in full bloom, and also Cornus Canadensis, Clintonia borealis, Trieatalis Americana, Arenaria lateriflora, Carum carui, Thaspium aureum, Potentilla Canadensis, Cornus stolonifera, Viola lanceolata, Vaccinium Canadense, V. Pennsylvanicum, Trifolium pratense, T. repens, Aralia nudicaulis. Apple trees (crab) were in height of bloom about 10th. Lilacs about 14th.

June 16th and 17th. A few ripe native strawberries were seen.

REPORT ON ZOOLOGY.

The Committee beg to submit the following notes: During the past season, Mr. Rowe has devoted much time to the study of fishes and fish culture, and has devised a hatching jar which is considered to possess advantages superior to those exhibited in any similar apparatus known to the committee. Mr. McIntosh has prepared a list of Bombycine and Hawk Moths which appears in this Bulletin, and Mr. Leavitt has made collections of fresh water shells and carried on some preliminary studies of our earthworms. Mr. G. W. Bailey has continued his investigation of our land shells and hopes to have his list ready for publication next year. The general subject has been brought before the Society in a number of papers.

INSECTS.

Last summer, owing no doubt to the exceptionally fine weather, injurious insects were unusually numerous. Locusts were very abundant and did quite an amount of damage.

Squash and cucumbers were almost entirely destroyed in some localitics by the striped cucumber beetle (DIABROTICA VITTATA, Fab).

Peas were very much injured by "worms" larvæ of weevils and a small moth, probably the Pea Moth (SEMASIA NIGRICANA Steph.)

After the immense swarms of the Cranberry Moth (CATERVA CATENARIA) which appeared in the autumn of 1899, it would seem natural to expect large numbers during the following season. But during the past summer scarcely a specimen could be found either in a larval or adult form.

One butterfly has been added to the New Brunswick list during the past summer (AMBLYSCIRTES VIALIS) and (ERYNNIS MANITOBA), hitherto only reported from Jacquet River, was taken in some numbers in the Nerepis Valley.

WILLIAM McINTOSH,

BIRDS.

The nnmbers refer to the list of birds printed in Bulletin No. 1, 1883.

SECTION A.

Species which occur in St. John and King's Counties:

20 Black-throated Blue Warbler (Dendroica cærulescens). A rare summer resident and only three specimens reported.
NOTE.—I took a fine male at Nerepis, September 22, 1900.

76 Rusty Blackbird (Scolecophagus Carolinus), given as an irregular summer resident.
NOTE.—In addition to the male reported in Bulletin XVII, page 73, in looking over my specimens, I find a pair taken May 11, 1893, at Lily Lake, a male on April 6, 1895, at Red Head, a male at Little River on May 8, 1895, and a female at the latter place on September 26, 1896.

79 American Raven (Corvus Corax sinuatus) given as "now rarely seen"
NOTE.—I have two good specimens (both males) one taken at Dipper Harbor on April 12, 1896, the other at Chance Harbor on April 22, 1896.

83 Shore Lark, or Horned Lark (Otocaris Alpestris), given as "lately rather uncommon."
NOTE.—My records show a female taken April 12, 1895, at Red Head, four females at the same place on April 3, 1896.

104 Yellow-billed Cuckoo (Coceyzus Americanus), given as a rare summer resident.
NOTE.—During 1900, these birds appeared to be quite numerous, and have been reported from Riverside and several places along the C. P. R. between St. John and Welsford.
I identified specimens on the Sandy Point Road and at South Bay, and collected a male at Nerepis on August 8, and Geo. Hare, Esq., took a male on the Red Head Road, September 5.

106 American Long-eared Owl (Asio Wilsonianus), given as an occasional *summer* resident.
NOTE.—I have a fine female taken at Point Lepreau on December 17, 1895, so it is probably also an occasional *winter* visitant.

107 Short-eared Owl (Asio Accipitrinus), only three instances of its occurrence given.
NOTE.—I have a female taken at Point Lepreau, November 20, 1900.

131 Mourning Dove (Zenaidura macroura), only three of this species reported.
I have a female taken on the West Beach Road, on September 24, 1899.

142½ (This No. to put species in proper position on list), Piping Plover (Argialitis meloda).
This species does not appear in Section A., Bulletin 1 (it is No. 243 in Section B), but on page 40 of Bulletin 2, four takes are recorded.
NOTE.—I have a male taken at Red Head, August 31, 1898.

150 Bonaparte's Sandpiper, a white-rumped Sandpiper (Tringa fuscicollis), given as "an occasional autumn visitant."

NOTE.—From my records, I find I took a male at Red Head, October 7, 1897, a female at the mouth of Little River, October 16, 1897, a female at the latter place, August 27, 1898, a female at Red Head, September 30, 1899, and on each occasion several were seen. It would seem in order to now report this species as "a regular autumn visitant."

152½ (No. to place species in proper position in list). Curlew Sandpiper (Tringa ferruginea). This species does not appear in Section A (it is No. 244 in Section B.)

NOTE.—I took a male at Red Head Marsh, August 3, 1895. This is the first report of this bird for this county.

168 Virginia Rail (Rallus Virginianus), given as "a common summer resident."

NOTE.—As far as my collecting or notes go, I have never met with this species, nor have I known of any collected, with the exception of a female (now in my collection) and taken at Gardener's Creek, September 8, 1899, by J. J. Wallace.

169 Sora Rail (Porzana Carolina), given as "an uncommon summer resident."

NOTE.—It certainly is a common autumn visitant, for never in the fall have I been on any of our local marshes without seeing the Sora, and my records show two females taken at Red Head—one on September 14, 1895, and the other on the 21st, a female at Little River, October 19, 1895, and a male at the latter place on October 9, 1896. I do not think there is a local "snipe shooter" who has not taken the "Sora."

190 Harlequin Duck (Histrionicus Histrionicus, given as "a rare spring and autumn visitant."

NOTE.—A pair were collected on April 16, 1896, and a male on April 20, 1896, at Point Lepreau. I now have the two former, and the latter is in the collection of this Society.

193 King Eider (Somateria spectabilis), given as "a rare winter visitant."

NOTE.—I now have a fine female taken at Point Lepreau, May 2, 1896.

209 Great Black-Backed Gull (Larus marinus), given as "an uncommon resident."

NOTE.—Two fine males taken at North Head, Grand Manan, January 7, 1898, one I now have, the other is in the collection of this Society.

A. GORDON LEAVITT.

THIRTY-NINTH ANNUAL REPORT

OF THE

COUNCIL

OF THE

NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

Your Council beg leave to submit the following report for the year now ending:

MEMBERSHIP.

Nineteen members were added in the course of the year, but owing to losses caused by resignations and change of residence, our actual gain is not large.

FINANCE.

The Treasurer makes the following statement of receipts and expenditures for 1899 and 1900:

Income.

1899.		
Balance from 1898		$ 98 07
Membership fees		137 00
Sale of Bulletins		28 35
Donations		22 00
Interest on investments		204 00
Dividends Botsford estate		20 00
Government grant		125 00
		$634 42

Disbursements.

Printing and distributing Bulletins	$144 47	
Library, books and binding	43 65	
Maintenance of Museum	93 28	
Miscellaneous	136 63	
Balance on hand	216 39	
		634 42

Receipts.

1900.		
Balance from 1899		$216 39
Membership fees		122 00
Bulletins sold		10 10
Interest on investment		26 00
Donations		40 43
Government grant		200 00
Dividends Botsford estate		20 00
Prizes for exhibit at Exhibition		10 00
Amount received and held in trust for Ladies' Association		33 00
		$677 92

Expenditure.

Printing and distributing Bulletin XVIII.	$161 31	
Maintenance of Museum	160 16	
Library, books and binding	25 59	
Miscellaneous	100 45	
		$447 51
Balance on hand		$230 41

A very large part of this balance will be required to pay for Bulletin XIX, now in press.

Library.

The library shows a large increase. Not only have important additions been made by exchange, but a number of works on botany have been purchased, and a large number of volumes bound. The contents of the library have been labelled and re-arranged, thus not only decidedly improving the appearance of the library, but making works on the various departments of natural science of easy access to students.

Publications.

Bulletin XVIII contains a number of valuable articles by Dr. Geo. F. Matthew, Prof. W. F. Ganong, D. L. Hutchinson and W. McIntosh; also Reports of the Fredericton Natural History Society, King's County Natural History Society, and the Natural History and Antiquarian Society of Prince Edward Island.

LECTURES AND ESSAYS.

Nine regular meetings were held, at which the following papers were read :

1900.

Jan.	2	Ornithological Notes of the Season of 1899, by A. Gordon Leavitt.
		Entomological Notes of the Season of 1899, by W. McIntosh.
		Notes on the Botany of New Brunswick, and Notes on a Wild Garden, by G. U. Hay.
Feb.	6	An Evening with the Microscope, by Dr. L. Allison.
Mar.	6	Notes on the Physiography of New Brunswick, by Prof. W. F. Ganong.
		How Ice Acts in Large Quantities, by W. S. Butler.
		Notes on Salamanders, by C. F. B. Rowe.
		The Natural History of Money, by Prof. John Davidson.
April	3	Birds' Eggs and Birds' Nests, by J. W. Banks.
		Note on the Physiography of New Brunswick, by Prof. W. F. Ganong.
		Mountains, Lakes and Rivers, by Prof L. W. Bailey.
May	1	Mines and Minerals of Newfoundland, by Dr. H. G. Addy.
Oct.	2	New Cambrian Fossils from Cape Breton, by Dr. Geo. F. Matthew.
		Note on Local Whirlwinds in New Brunswick, by S. W. Kain, published in U. S Weather Review, November, 1900.
Nov.	6	The Physiography of the South Tobique Lake Basin, by Prof. W. F. Ganong.
		Observations in Wild Garden at Ingleside, by G. U. Hay.
		Introductory List of Hawk and Bombycine Moths, by W. McIntosh.
		Notes on Two Fragments of Aboriginal Pottery, by S. W. Kain.
Dec.	4	Notes on Some of our Freshwater Fishes, by C. F. B. Rowe.
		Additions to the List of New Brunswick Fungi, by G. U. Hay.
		Notes on the Archæology of New Brunswick, by S. W. Kain.

In addition to the regular lecture course, the following elementary lectures were delivered :

ZOOLOGY : G. F. MATTHEW, D. SC.

Jan.	9	The Annelida or Worms.
	23	The Brachiopoda or Lamp Shells.
	30	The Entomostraca or Water Fleas.

BOTANY : G. U. HAY, M. A.

Feb.	13	Ferns. Their Habits, Haunts and Distribution.
	20	Fungi. Their Nature, Uses and Distribution.
	27	Lichens and Algæ.

Archæology.

During the year there has been an encouraging interest taken in the study of archæology. David Boyle, Duncan London, Dr. Smith of Tracadie, and others, have donated interesting specimens to the museum. Dr. Geo. F. Matthew read a paper on this subject at the May meeting of the Royal Society, which will be published in the next volume of Transactions. In another paper on the Rockwood Bog, the same author draws attention to certain evidences of the early appearance of man. This paper appeared in the Canadian Record of Science for July, 1900. Mr. S. W. Kain has also carried on archæological studies, and a paper from his pen appears in this Bulletin. In another paper, which also appears in this Bulletin, Messrs. Kain and Rowe figure and describe some relics of the early French occupation of the province. The Committee on Archæology state that a new case for their department is urgently needed.

Ornithology.

The Committee on Ornithology report several donations of birds to the museum. Two lectures have been delivered on Bird Life. The specimens in the museum have received the usual care; and much valuable field work has been done by members of the Society.

Entomology.

The Entomological Committee report that continued interest is taken in the study of insect life. During the past year much valuable work has been done in this branch of nature study. Systematic collecting has been carried on by members of the Society, particularly in the vicinity of St. John and in the Nerepis valley. About 450 specimens have been sent to experts for identification. Many of these have proved of extreme interest to entomologists.

Field Work.

During the summer three field meetings were held. The first was held at Ingleside. Among those present were Prof. W. F. Ganong and W. A. Hickman.

The second was held at Red Head. Here the fossils in the clay-beds were examined, and a well-defined example of post-glacial faulting was noted on a rocky point to the southward of Dr. H. G. Addy's summer residence.

The third meeting was held at Rockwood Park.

During the summer Dr. Geo. F. Matthew spent three weeks examining the Cambrian deposits of Cape Breton, and Prof. L. W. Bailey spent the season studying the metamorphic rocks of York and Carleton Counties.

Prof. W. F. Ganong explored some little known regions in the Tobique district, and some of the results of this trip have already been laid before you. He was accompanied by Mr. G. U. Hay, who made observations on the flora of the same region.

Messrs. McIntosh, Leavitt and Rowe made a number of trips to the Nerepis valley. Large collections of insects were made by Mr. McIntosh; Mr. Leavitt studied the bird life, and made a collection of the freshwater shells; and Mr. Rowe studied the fishes of the valley.

Centennial of the University.

The occupants of the chair of natural history in the University of New Brunswick (Dr. James Robb, 1837–1861, Prof. L. W. Bailey from 1862), have always been in active sympathy with the work of scientific investigation, and the present occupant of that chair has been one of our most loyal and talented workers. Thus there is a bond of common interest between the Society and our provincial university; and, on invitation, we sent a delegate to the centennial exercises, conveying congratulations and wishes for prosperity. Delegates were present on that occasion representing many of the great institutions of learning, and it was probably the most notable educational gathering ever assembled in this province. Mr. Samuel W. Kain represented our Society.

General.

The rooms of the Society are open to the public on Tuesday, Thursday and Saturday afternoons, and the large number who avail themselves of the opportunity of examining the collections prove the wisdom of opening the rooms to the public.

A great improvement will be seen in the library. The floor has been covered with linoleum, and a new table, chair and stove were kindly furnished by Dr. Matthew, thus adding greatly to the appearance and comfort of the room. These improvements are due, in a great measure, to the efforts of the ladies of the Society.

The conversazione and science supper held by the associate members was a brilliant success financially and otherwise. The temperance organization kindly permitted the Society to use their rooms. Addresses were delivered by President Addy, His Worship Mayor Daniel, Mr. G. U. Hay, and others. Supper was served by the ladies, and the evening was pleasantly and profitably spent in examining the Society's collections.

At the request of the Exhibition Association the Society occupied a space in the exhibition building. Geological, archæological, zoological and botanical specimens were shown, and attracted a great deal of attention. The live fish part of the natural history exhibit was the most popular feature of the exhibition, and reflected great credit on Mr. C. F. B. Rowe, who collected nearly all the specimens shown.

During the year a microscopy section was organized. Officers were elected and a number of meetings held, which were well attended. It is hoped that the interest will continue in this useful and important branch of the Society's work.

The Society tenders a grateful acknowledgment to the press of St. John for the free insertion of notices and reports of meetings, and also to those who have contributed to the various lecture courses.

The past year has been a progressive one for the Society. There has been a gain in membership; lectures have been delivered, and papers read on almost every branch of nature study; the meetings have been well attended, and valuable additions have been made to the museum and library.

Much important field work has been done by members, and the work of the Society has in almost every department been eminently satisfactory.

Respectfully submitted,

WILLIAM McINTOSH,
Secretary to Council.

Natural History Rooms, Market Building,
January 15th, 1901.

THE FREDERICTON NATURAL HISTORY SOCIETY.

(Instituted February 2, 1895).

The Society still holds its meetings in the High School building, but has changed the date from the third Monday to the second Monday of the month. The attendance during the year has been good.

Since last report, papers have been read (or addresses given) as follows:

1900.	
Jan. 8	Leaves, by L. W. Bailey, Ph. D.
Feb. 12	Crystals, Gems and Precious Stones, by Dr. Bailey.
Mar. 12	The Pendulum, by Dr. Scott.
May 14	Rivers, Lakes and Mountains, by Dr. Bailey.
Oct. 14	Scenery and its Causes, by Dr. Bailey.
Nov. 12	Fire, by H. H. Hagerman, M. A.
Dec. 10	Forms of Energy, by Mr. John Brittain.
1901.	
Jan. 14	Nothing but Leaves, by B. C. Foster, M. A.

The officers for the year ending February, 1901, are as follows:

L. W. Bailey, Ph. D., LL.D. .... *President.*
G. N. Babbitt, Esq ....,.... *Vice-President.*
B. C. Foster, M. A .... *Treasurer.*
John Brittain .... *Secretary.*
H. H. Hagerman, M. A. .... *Curator.*

MEMBERS OF COUNCIL:

Geo. A. Inch, B. A., B. Sc., W. T. L. Reed, W. B. Coulthard, Mrs. W. B. Coulthard, Miss Ella Thorne.

JOHN BRITTAIN,
Secretary.

NOTE.—The editors regret that the reports from the Kings County Natural History Society and the Natural History and Antiquarian Society of Prince Edward Island were not received in time for publication.

DONATIONS TO THE MUSEUM, 1899-1900.

Date.	Donor's Name and Description of Article.
1899. Feb.	Mr. Marshall Reid, Dalhousie, N. B., Plants (dried).
Mar.	Mrs. J. H. Tillotson, Coral from Bermuda.
April.	Mr. Jas. F. Robertson, Octopus, Flying Fish, Cow Fish; West Indies.
	Mrs. A. McN. Travis, Hampton, N. B., Star Fish, two Meteoric Stones.
	Messrs. Smith & Tilton, Cards illustrating British Fauna and Flora.
	Dr. W. F. Ganong, Compound Microscope.
	Mr. G. U. Hay, 130 plants, Northern New Brunswick (mounted).
May.	Mr. S. W. Kain, Clay Vessel from Philippine Islands.
	Mr. J. S. McLaren, two cannon balls, Gowan Brae, near Bathurst, N. B.
June.	Capt. Aikman (of S. S. "Peerless") foot of one of Rameses' (the Great) Princess, from Assouan. Lizard, third Cataract of the Nile. Reed Flute, as used in time of Moses—Upper Egypt. Rose of Jericho. Seven coins from ruins of buried city, on site of which Pompey's Pillar stands. Eight coins from ruins of old Alexandria.
	Capt. E. C. Elkin, Specimen from Gold King Mine.
	Mr. T. H. Lawson, Branch of tree grown after being knotted; St. Martins.
	Dr. G. F. Matthew, Fossils—Ordovician—Maclurea, Orthoceras, Murchisonia, Graptolites. Spirefer, Endoceras, Lituites, Worm Burrows; from Port au Port, Newfoundland.
	Mr. S. W. Kain, Clay Flower Pot, Buenos Ayres.
Oct.	Mr. Thos. H. Lawson, Stone with oysters attached, Perth Amboy. N. J.
	Mr. Duncan London, Maquapit Lake, Queens Co.—Slab of Sandstone, with conical holes bored in it (see page 287). Pitted Stone (see page 289). Natural Axe-formed Boulder, partly grooved. Celt used as hammer or chest tool. Three Celt-shaped boulders that were used as hammers. Broken Celt, chafed and striated on edges. Broken Axe. Hammer Stone bruised at ends. Chipped Boulder edged for Celt. Box of Stone Chips, Chalcedony, Carnelian, Jasper and Quartz. Box of pottery fragments, various patterns.
	Capt. W. J. Foster (Schooner "Abbie and Eva Hooper"), Magnesite from Greece.

DONATIONS TO THE MUSEUM—CONTINNED.

DATE.	DONOR'S NAME AND DESCRIPTION OF ARTICLE.
1899. Oct.	Dr. A. C. Smith, Tracadie, N. B.—1 Celt; 1 scraper or digger = hoe; 2 spear heads: 4 javelin points; 1 leaf-shaped weapon; 15 arrow heads (notched bases); 4 arrow heads (tined bases); 4 arrow heads (wedge bases); 1 rimmer; 1 base of a pipe.—South Tracadie Gully.
	1 kettle, site of French Fort, Shippegan Island; 1 large kettle; 2 small kettles; 1 sword; 1 harpoon; 1 skull; bottle beads; knives, etc. —Taken recently from Indian graves, Wilson's Point.
	Capt. Aikman (S. S. "Peerless"), Egyptian Snake, five feet long; 2 Egyptian Lizards; 5 Egyptian Beetles; 23 large Egyptian and other photos; Mummified Falcon from tomb of Rameses II.
	Dr. G. F. Matthew, Specimen of Peat with charcoal fragments, Rockwood Park. Natural slate pencils, Cape Breton.
	Mr. Jackson, large Cedar Burr.
	Mr. John Moser, Mounted specimen Arctic Tern from Canaan Forks.
Nov.	Mr. T. E. Colpitts, Fossils of Carboniferous Period.
	Mr. Joseph Allison, Relic of French Period.—Horton Landing, N. S.
Dec.	Mr. Wm. McIntosh, 150 specimens native Coleoptera.
1900. Feb.	Mrs. G. N. Golding, a number of Chinese curiosities.
	Miss Emma Titus, a large number of botanical specimens.
	John S. McLaren, a number of Fossils.
Mar.	Mrs. Geo. F. Matthew, on behalf of the Department of Vertebrate Palæontology of the Metropolitan Museum of New York, suite of photographs of the Great Dinosaurs and Dinotheres.
	D. Balmain, Indian Point, Queens Co.—Three Indian skin-scrapers.
	John Kerr, Bowl of Indian trade pipe of the seventeenth century, found at Old Fort, St. John, N. B.
April.	P. W. McNaughton, Fossil Fern from Joggins.
May.	David Boyle, Toronto.—Collection of flint arrowheads from Norfolk County, Lake Erie shore.
	Dr. H. Geo. Addy, Mounted specimen of Red-tailed Hawk.
Oct.	Prof. W. F. Ganong, Stone Implements.
	Duncan London, Sunbury County.—Aboriginal Stone Implements.

DONATIONS TO THE MUSEUM — CONTINUED.

DATE.	DONOR'S NAME AND DESCRIPTION OF ARTICLE.
1900. Oct.	W. A. Kain, Cannon Ball from the Restigouche.
	A. Gordon Leavitt, Clam Shells from Kings County and Harrigan's Lake; also specimens of Iron Pyrites.
	Miss Henrietta Calhoun, Albert Mines.—Mounted Birds in case.
	J. L. S. des Brisay, a Malformed Lobster Claw from Baie Chaleur.
Nov.	Mrs. G. R. Prichard, two Arrow or Spear Heads, portion of Fossil Tree, and Horseshoe Crab.
	Anonymous. Hercules Beetle from the West Indies, and one East India Beetle.
Dec.	Duncan London, Pieces of aboriginal pottery.
	Poole Pottery Co., Clay vessel to illustrate Indian pottery decoration.
	W. M. P. McLaughlin, Copper Ores from the Great Mammoth Mines, Index District, Washington.
	Ernest O. Thompson, Woodpecker's nest.

Dr. G. F. Matthew presented a walnut library table, an arm-chair and a stove, furnishings for the library.

DONATIONS TO THE FUNDS.

Anonymous	$20 43
"	10 00
"	10 00
	$40 43

DONATIONS TO THE LIBRARY, 1900.

DONOR'S NAME.	RESIDENCE.	WORK.
Academy of Natural Sciences	Philadelphia	Proceedings.
Academie Imperiale des Sciences	St. Petersburg.	Bulletins.
Acadia College Library	Wolfville	Report.
American Entomological Society.	Philadelphia.	Circulars.
American Journal of Science and Art	New Haven	Circulars.
American Museum of Natural History	New York	Bulletins.
American Philosophical Society.	Philadelphia	Report.
Anthropological Society of Washington	Washington	Transactions.
Astronomical and Physical Society of Toronto	Toronto	do.
Australian Association for Advancement of Science	Sydney, N. S. W.	Bulletins.
Australian Museum	do.	Report.
Amherst College	Amherst, Mass	do.
Belfast Naturalists' Field Club	Belfast	Bulletins.
Boston Free Public Library	Boston	Reports.
Boston Society of Natural History	do	Bulletins.
Bowdoin College Library	Brunswick, Me.	Reports.
Brazil National Museum	Rio de Janerio	do.
British Columbia Natural History Society	Victoria	Bulletins.
British Museum (Natural History)	London.	Reports.
Brooklyn Entomological Society.	Brooklyn	Circular.
Buffalo Society of Natural Sciences	Buffalo	Bulletins.
Bureau of Ethnology	Washington	Transactions.
California Academy of Sciences.	San Francisco	Proceedings.
Canadian Institute	Toronto	Transactions.
Cincinnati Society of Natural History	Cincinnati	Bulletins.
Cincinnati Museum Association	do.	do.
Colonial Museum	Wellington, N. Z.	Proceed. and Transac.
Colorado Scientific Society	Denver	Transactions.
Columbia College	New York	Report.
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Director Royal Gardens	Kew, G. B.	Bulletins.
Department Inland Revenue	Ottawa	Annual Report.
Department Indian Affairs	Ottawa	do.
Education Office	Fredericton	Pamphlet.
Elgin Historical and Scientific Institute	St. Thomas	Bulletins.
Entomological Society	London, Ont	Journal.
Essex Institute	Salem, Mass	Bulletins.
Feuille des Jeunes Naturalists	Paris.	Journal.
Field Columbian Museum	Chicago	Reports and Bulletins.
Field Naturalist Club	Ottawa	Ottawa Naturalist.
Geological Society	Edinburgh	Proceedings.
Geological Society	London	do.
Geological Survey	Ottawa	Reports.
Gray Herbarium of Harvard University.	Cambridge	Bulletins.
Hamilton, Mrs. Geo. A.	St. John	Six Volumes.
Hamilton Association	Hamilton	Journal.
Harvard Library.	Cambridge	Reports.
Historical and Scientific Society of Manitoba	Winnipeg	Bulletins.
Illinois State Museum		Report.
Iowa Academy of Sciences	Des Moines	Report and Circulars.
Iowa Geological Survey	do.	Report.
Indiana Department of Geology	Indianapolis	Proceedings.
Johns Hopkins University	Baltimore	Circulars.
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Literary and Historical Society	Quebec	Transactions.
Liverpool Biological Society	Liverpool	Proceed. and Transac.
Geological Society	Liverpool	do. do.

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Manchester Geological Society	Manchester	Proceed. and Transac.
Marine Biological Laboratory	Plymouth, G. B.	Journal
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Meriden Scientific Association	Meriden	Bulletin.
Minnesota Academy of Natural Sceinces	Minneapolis	Bulletins.
Missouri Botanical Gardens	St. Louis	Report.
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Maryland Geological Survey	Baltimore	Annual Report.
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Public Museum	Wanganui, N. Z.	Proceedings.
Rochester Academy of Science	Rochester	Proceedings.
Royal Academy of Sciences	Stockholm	do.
Royal Colonial Institute	London	Journal.
Royal Geographical Society	do.	Journal.
Royal Geological Society of Ireland	Dublin	Proceed. and Transac.
Royal Society	London	Proceedings.
Royal Society of Canada	Ottawa	Proceed. and Transac.
Royal Society of Tasmania	Hobart Town	Proceedings.
Royal Swedish Academy of Sciences	Stockholm	do.
Royal University of Upsala	Upsala	Bulletin.
Smithsonian Institution	Washington	Report and Proceed.
Societe Geologique de France	Paris	Report.
Societe Geologique du Nord	Lille	Transactions.
Societe Geologique de Belgique	Liege	do.
Societe Malacologique de Belgique	Brussels	Bulletin.
Societe Scientifique du Chile	Santiago	Bulletin.
South Dakota School of Mines	Rapid City	Reports and Bulletins.
State Geologist	Perth, W. A.	Statist.
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Tacoma Academy of Science	Tacoma	Proceedings.
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Tufts College	Mass	Studies.
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U. S. Coast and Geodetic Survey	Washington	Report.
U. S. Commissioner of Agriculture	do	Bulletins.
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U. S. Geological Survey	do	Reports and Bulletins.
Wagner Free Institute of Science	Philadelphia	Report.
Wisconsin Academy of Science, Art and Letters	Madison	Bulletin.
Wisconsin Natural History Society	Milwaukee	Proceedings.
Wyoming Historical and Geological Society	Wilkes-Barre	Bulletin.
Yorkshire Geological and Polytechic Society	Leeds	Report.

PURCHASED.

British Fungi (Hymenomycetes). Two Volumes. By Rev. John Stevenson.

American Fungi, 1900. By Charles McIlvaine.

Prehistoric Implements, 1900. W. K. Moorehead.

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METEOROLOGICAL ABSTRACT FOR 1900.

Observations Recorded at St. John Observatory, Latitude, 45° 17′ N.; Longitude, 66° 4′ W.

D. L Hutchinson, *Director.*

	Barometer.			Temperature.			Cloudiness: 0 = clear; 10 = wholly clouded.	Precipitation: Rain and melted snow.	Wind Direction and Velocity.																		Thunder Storms.
									N.		N. E.		E.		S. E.		S.		S W.		W.		N. W.				
	Mean.	Highest.	Lowest.	Mean.	Maximum.	Minimum.			Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours Calm.	Total Miles.	
January	29.96	30.81	28.90	22.1	48.2	−7.5	6	5.52	181	1029	58	832	17	189	51	1042	24	420	187	3732	83	1080	171	2674	22	10,998	0
February.......	29.95	30.74	28.85	22.6	47.3	−9.6	6	6.07	58	469	88	1833	71	843	40	827	7	94	59	1104	66	1010	268	4729	15	10,409	0
March..................	29.91	30.75	29.42	26.8	42.2	−5.2	5	4.16	69	790	57	729	44	1060	45	916	51	690	108	1592	61	590	301	5191	18	11,558	0
April	29.86	30.45	29.32	40.1	63.5	22.3	5	4.01	35	549	104	1413	36	353	28	370	32	142	92	784	20	133	257	3267	116	6,911	0
May	29.94	30.32	29.43	47.1	86.7	31	6	6.14	26	186	63	671	59	268	94	925	77	461	156	1791	53	294	166	2151	45	6,747	2
June............	29.92	30.32	29.53	58	82.6	40.9	5	4.98	14	47	75	640	31	172	76	660	178	1139	191	2108	27	211	107	1552	26	6,529	2
July............	29.92	30.19	29.48	62.6	77.7	48.3	6	1.42	29	138	23	148	19	91	56	247	210	1002	182	1964	15	141	117	1380	88	5,111	2
August....	30.01	30.32	29.60	63.1	88.6	48.4	6	2.19	61	345	127	1212	34	246	53	346	138	739	134	1260	12	60	109	1066	76	5,274	3
September......... ...	30.06	30.39	29.05	56.3	74	35	4	2.33	73	578	104	973	11	56	47	297	116	754	192	2035	19	47	83	1028	75	5,768	0
October.	30.17	30.60	29.46	50.3	70.6	23.5	6	10.17	36	265	173	1749	32	221	48	257	77	358	100	892	47	418	122	1740	109	5,920	0
November.............	30.00	30.54	29.11	38.2	58.2	14	7	4.34	27	131	136	1710	17	96	64	797	29	297	128	2473	46	490	177	2547	96	8,541	0
December.............	29.97	30.50	29.27	23.7	45	−6.6	5	6.87	96	585	91	1021	....	...	....	...	3	35	71	1058	92	664	273	3605	118	6,996	0

Barometer readings have been reduced to sea level and 32° Fahrenheit. The minus sign when used indicates temperatures below zero. The maximum temperature, 88.6, was registered on the 27th of August; the minimum, −9.6, on the 27th of February. The total precipitation for year was 58.20 inches.

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BULLETIN

OF THE

NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

No. XX.

VOLUME IV. PART V.

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1902.

ARTICLE I.

ADDITIONAL NOTES ON THE CAMBRIAN OF CAPE BRETON, WITH DESCRIPTIONS OF NEW SPECIES.

By G. F. MATTHEW, LL.D., F.R.S.C.

A visit to the Cambrian areas in Cape Breton during the past summer has enabled the writer to supplement his observations on the range and structure of the Cambrian System in that island.

As a full statement of the results of observations in that island in this and the two previous years will be embodied in a report to the Geological Survey of Canada, only a very brief outline will be given here.

In consequence of the finding of trilobites and Cambrian genera of Brachiopods, etc., in the Etcheminian strata, the writer proposes to revert to the classification of 1889, wherein these deposits are called the Basal Series (of the Cambrian System).*

Further, it has been found that slates with fossils of Cambrian genera are included in the important group of volcanic rocks which lie at the base of the Etcheminian, and that where the dip of the volcanics can be found, as is not infrequently the case, it agrees with that of the Etcheminian. It is thought therefore that those volcanics, (the Coldbrook group) should be included in the Basal Cambrian.

Both in New Brunswick and in Cape Breton the Coldbrook group begins with lavas showing deposition free of pressure, as they are amygdaloidal; or with agglomerates devoid of evidence of marked aqueous wear. The deposition therefore did not begin in deep water, or on exposed sea coasts, or under heavy pressure.

The foundation upon which the volcanics rest shows in several places marks of deep sub-aerial decay at the line of contact. Calcareous bands are dissolved, leaving the silicious portion of the strata. The feldspar of the granitic rocks is kaolinized, and the magnesian

* Trans. Roy. Soc. Can., vol. vii, Sec. iv, p. 135.

silicates are hydrated, impure graphite beds are changed to a black amorphous crumbling shale, and a depression or narrow valley is usually found at the contact of the two terranes. These conditions appear to indicate that the pre-Cambrian complex had long been above the sea-level in these districts when the first Cambrian effusives were thrown out upon it.

Another point worthy of note in this connection is the large amount of feldspathic material in the Etcheminian beds: the very sands are often composed of feldspathic grains, and these largely of unkaolenized feldspar, as though they had not been exposed to subaerial decay. Feldspar in this condition is found in two kinds of deposits, those that are the result of glacial wear and those found around volcanic vents, where particles of rock have been torn from the walls and blown out upon the surface of the earth. These if dropped into the sea would soon be covered up by fine mud and preserved in their original crystalline condition. The Etcheminian appears to represent the submarine condition of these effusive rocks.

On the other hand the Coldbrook series, as has been intimated above, represents the preceding sub-aerial phase of the eruptives. It is true that we find in many places conglomerates at the contact of these two series of rocks, so diverse in appearance: but elsewhere there are no beds of rolled fragments at the contact, and the passage is direct from ash-beds or diabases, to the slates and sandstones.

In reports of the Canadian Geological Survey of 1870–71, pp. 57–59, etc, both these groups of rocks have been included in the Huronian System. They may be equivalent in age to the upper part of that series, but unfortunately the absence of fossils in the original Huronian leaves this matter in doubt.

As we contemplate the physical conditions of the initial epochs of Cambrian time in the Maritime Provinces, we seem to see a region long elevated above the sea, now subjected to depression nearly to the sea level, the depression being accompanied with extrusion of lavas and volcanic mud and the ejection of stones and ashes. These at first were cast upon a land surface, but, as the crust of the earth continued to sink, into sounds and bays of a shallow sea, diversified with pre-Cambrian ridges and islands, of greater or less extent.

For the above reasons as well as because the stratified rocks of the underlying complex are markedly unconformable to the Cam-

silicates are hydrated, impure graphite beds are changed to a black amorphous crumbling shale, and a depression or narrow valley is usually found at the contact of the two terranes. These conditions appear to indicate that the pre-Cambrian complex had long been above the sea-level in these districts when the first Cambrian effusives were thrown out upon it.

Another point worthy of note in this connection is the large amount of feldspathic material in the Etcheminian beds; the very sands are often composed of feldspathic grains, and these largely of unkaolenized feldspar, as though they had not been exposed to subaerial decay. Feldspar in this condition is found in two kinds of deposits, those that are the result of glacial wear and those found around volcanic vents, where particles of rock have been torn from the walls and blown out upon the surface of the earth. These if dropped into the sea would soon be covered up by fine mud and preserved in their original crystalline condition. The Etcheminian appears to represent the submarine condition of these effusive rocks.

On the other hand the Coldbrook series, as has been intimated above, represents the preceding sub-aerial phase of the eruptives. It is true that we find in many places conglomerates at the contact of these two series of rocks, so diverse in appearance; but elsewhere there are no beds of rolled fragments at the contact, and the passage is direct from ash-beds or diabases, to the slates and sandstones.

In reports of the Canadian Geological Survey of 1870–71, pp. 57–59, etc, both these groups of rocks have been included in the Huronian System. They may be equivalent in age to the upper part of that series, but unfortunately the absence of fossils in the original Huronian leaves this matter in doubt.

As we contemplate the physical conditions of the initial epochs of Cambrian time in the Maritime Provinces, we seem to see a region long elevated above the sea, now subjected to depression nearly to the sea level, the depression being accompanied with extrusion of lavas and volcanic mud and the ejection of stones and ashes. These at first were cast upon a land surface, but, as the crust of the earth continued to sink, into sounds and bays of a shallow sea, diversified with pre-Cambrian ridges and islands, of greater or less extent.

For the above reasons as well as because the stratified rocks of the underlying complex are markedly unconformable to the Cam-

Ffestiniog and Maenterog.	Menevian.	Solva.	Caerfai.		Pebidian?
c. Agnostus, Lingulella. (Place of Olenus).	b. *Paradoxides*, Beyrichian, Lingulepis. a. Obolus, Lingulella, Lingulepis. d e. *Paradoxides*, Solenopleura, Ptychoparia, Microdiscus.	c. *Paradoxides*, Conocoryphe, Liostracus, Agnostus. a-b. *Protolenus*, Ellipsocephalus, Beyrichona, Trematobolus, in S. New Brunswick.	Ptychoparia? Ostracoda, 4 genera. *Acrothele*, Lingulella, Obolus. Acrothyra, Hyolithes.	*Holasaphus*, Paradoxidoid trilobite, Ostracoda, Billingsella, Lingulella, Acrothyra, Obolus, Hyolithes. Lingulella, Leptobolus, Obolus, Acrothyra, Acrotreta, Hyolithes.	Lingulella, 2 Ostracoda. Acrothyra, Acrotreta.
			3. Upper.	2 and 1, Lower.	
2. Johannian.		1. Acadian.	Etcheminian.		Cold-brookian.
nordeal Cambrian.			Basal Cambrian. (mihi).		
(True or) Eu Cambrian.			Sparagmite Formation, Norway.		
Geological Reports.			Huronian of Geological Reports.		
2. Micaceous gray slates, flagstones and quartzites. Iron bearing in Mira Valley, Cape Breton.	1. Dark gray slates or shales with calcareous lentiles. Gray sandstones. Interraned conglomerates at and near the base.		3. Fine greenish gray argillites, some reddish gray. Horizon of roofing slates, in C. Breton and Newfoundland.	2. Red sandstone and red and gray argillite. Lower iron-bearing horizon of Cape Breton Cambrian. 1. Gray shale or slate with some quartzite and conglomerate, the latter especially at the base.	Co. Dolerites, breccias and amygdaloidal ash rocks. Some gray shales toward the top.

brian, the volcanics are thought to belong to the latter, and to give the natural base of this system.

The accompanying table will then show the classification of the Cambrian System, as seen in the Maritime Provinces of Canada. *(See accompanying sheet.)*

In this table we have been able to present one of the faunas of the European Cambrian, heretofore unrecognized in Eastern Canada, *i. e.*, the Tremadoc fauna of English writers, the Ceratopyge fauna of the Swedes (the Euloma-Niobe fauna of Prof. W. C. Brogger), the Dicellocephalus fauna of Mississippi valley.

This is based on the discovery of examples of Asaphellus, Parabolinella and Triarthrus in soft shale on the upper part of McLeod Brook, in Boisdale district. It happens that at St. John the strata which would carry this fauna is in the channel of the river in the upper part of the harbor of St. John, with the Dictyonema fauna on one shore, and the Tetragraptus fauna on the other, hence it has not been recognized in the St. John Basin.

Also, the strata of Division 2 of the St. John group, the Johannian division, which we have all along spoken of as the probable place of the Olenus, it would seem will have to be assigned largely to the Paradoxides Zone, since Mr. Loper, who has been collecting in Cape Breton for the U. S. Geological Survey, has found a *Paradoxides*, which proves to be a variety of *P. Forchhammeri*, in the middle of this Division. From this it may be inferred that the two lower bands (*a* and *b*) of this division may be assigned to the Paradoxides zone. I had found in the Mira R. Cambrian a cheek of Paradoxides type in this division, but this alone was not sufficient to determine the presence of this genus in the Johannian division.

Another important point made during the past season was, that the strata at Young's Point (or McFee's Point), from which the fossils came, collected by Messrs. Weston and Robert many years ago for the Canadian Geological Survey, and which the author had described, and referred (on account of their resemblance to European forms) to the Ordovician fauna, are in the Etcheminian or basal Cambrian. The more abundant material gathered since Messrs. Weston and Robert's visit, show that the species referred by me to Orthisina is a Billingsella. The Holasaphus does not agree with any other basal Cam-

brian trilobite so far described; but the Hyolithes may be a form of *H. americanus* of Billings.

The writer has suggested the possibility that from the composition of the Hastings Cove Paradoxides fauna, the genus Olenellus, sens. strict., might occur above Paradoxides. This now seems the less probable from the occurrence in Cape Breton of the latter genus as high up as the middle of the Johannian division, where Olenus would naturally be looked for. It would seem that Olenellus must occur lower down than the Johannian division.

New Species of the Etcheminian or Basal Cambrian.

1.—*Development of the genera Acrothyra, Acrotreta and Acrothele.*

The value of small species of fossils in determining geological horizons is well shown in Tullberg's monograph on the Agnosti, of which genus certain types are peculiar to special horizons of the Cambrian and of the Ordovician. A small fragment of rock only has been found sufficient, when containing certain Agnosti, to determine the age of a group of strata.

I hope it may hereafter be possible to use the three genera above mentioned in a similar way for determining the age of parts of the Etcheminian and the higher Cambrian, where these genera occur. It is as a contribution to this object that the writer presents here descriptions of such species and varieties as have been recognized in the Canadian Cambrian rocks.

It will be seen that so far as our knowledge goes, the first two genera are among the oldest that have been recognized in the Cambrian rocks of Eastern Canada, since they are found among the volcanics that lie at the base of the Palæozoic terranes, as well as higher up in the Cambrian; and they were distinct from each other, even at that early time.

The following table shows the distribution of these early forms of Brachiopods in the basal Cambrian rocks and their relative abundance at Dugald Brook at the several horizons at which they occur:

DISTRIBUTION OF ACROTHYRA AND ACROTRETA IN THE COLDBROOKIAN AND ETCHEMINIAN OF CAPE BRETON.

These species and mutations are described in the following pages.	COLDBROOK.	ETCHEMINIAN. 1 a	1 b	1 c	1 d	1 e	2 a	2 b	2 c	3 a	3 b	3 c	3 d	3 e	3 f
Acrothyra signata			**7**												
——— ——— prima	18														
——— ——— sera				59											
——— ——— tarda				6	24			1							
——— ——— orta									3						
A—— proavia													6	**160**	
A—— ——— prima										7					?1
A—— ——— crassa														1	?1
Acrotreta papillata				2	**25**										
A—— ——— prima	1														
A—— sp							1 ?								

N. B.—The figures in the columns show the number of individual shells examined. The horizons where the types of these species are found are marked by heavy faced numbers. Only the ventral valves are recorded in this table.

ACROTHYRA.

For the characteristics of this genus see this Bulletin, Volume IV, page 303.

ACROTHYRA SIGNATA, n. sp. Plate XIII, figs. 2 *a–e*.

Valves corneous or calcareo-corneous, tumid, rather thick shelled.

Ventral valve—Oval, pointed at the umbo, beak depressed and sides compressed. Hinge area oblique. *Interior.*—There is a strong narrow callus, one-third of the length of the valve, bounded by a raised ridge at the sides and in front; at the front of this callus is an oval pit, from which a groove runs backward nearly to the apex of the

shell, where it is supposed to connect with the foramen. Outside the callus, on each side, near the margin of the valve, are lenticular marks of the lateral muscles. About the middle of the valve the position of the anterior adductors is indicated by a faint impression of the lozenge or "heart-shaped" depression. The margin of the valve is thickened.

The *dorsal valve* is orbicular, strongly convex, and has a somewhat triangular appearance, because of the sides being depressed from the umbo, and because the front is strongly bent downward. *Interior.*—This shows a sharp, thin, median septum for half of the length of the valve. This ridge is broader and more distinct at the front; at each side are lateral obscure ridges, diverging from the umbo. Outside of these ridges are the lenticular imprints of the lateral muscles.

Sculpture.—The surface of this shell (which perhaps is not the real outer surface) is shining, and has fine, concentric ridges visible only with a lens.

Size.—Length of the ventral valve, 3 mm.; width, 2 mm.; depth, 1 mm. In the dorsal the length and breadth are equal, and the depth is less than that of the ventral.

Horizon and locality.—This species is found in Assise *b* of the lowest Etcheminian Zone at Dugald Brook, a branch of Indian Brook in Escasonie, N. S.

On a cursory examination the ventral valve of this shell might pass for that of a Lingulella, but the closed deltidial area is that of Acrotreta and Acrothyra; the form of the dorsal and the nature of its interior show that the species is closely related to Acrotreta.

ACROTHYRA SIGNATA-PRIMA. Plate XIII, figs. 1 *a–g*.

Test (calcareo-)corneous; valves tumid. *Ventral valve* variable in form, longer than broad, often quite tumid, with the posterior half straighter than the anterior, which in some examples is strongly arched down toward the margin. Hinge area variable in height, beak sometimes overhanging the hinge, sometimes withdrawn from the perpendicular. *Interior*—There is a visceral callus from one-quarter to one-third of the length of the valve, wider in front than behind, bordered by vascular grooves; the central depression is deeper toward the apex than toward the front. Outside of the aforesaid grooves is another and a shorter pair, more widely diverging; traces of the lateral muscle scars are seen outside of this latter pair of grooves.

The *dorsal valve* is more regular in form than the ventral, but also often quite tumid. The umbo is low and close to the margin. *Interior* —This possesses a shallow median septum extending to the middle of the valve; on each side of the septum, at the hinge line, are pits for the cardinal muscle. A pair of diverging grooves in the posterior half of the valve mark the position of the lateral muscles.

Both valves have thickened borders and are flattened along the lateral margins.

Considering the variableness of this form one might be disposed to think it a mutation of *A. signata*, and it is so classed here; but the following differences are apparent: The visceral callus of the ventral valve is broader and not so distinctly impressed, and the groove at the posterior end project farther backward. In *A. signata* the callus does not have the strong bounding ridges that this frequently is seen to have. The cardinal area in this form never has the extreme overhang that marks *A. signata*, and the back part of the ventral valve is not produced.

Sculpture.—The surface is smooth, but a strong lens reveals fine concentric ridges at intervals on the surface of the shell.

Size.—Ventral, length, $2\frac{1}{2}$ mm.; width, $2\frac{1}{4}$ mm.; depth, $1\frac{1}{4}$ mm. Dorsal, length and width, $2\frac{1}{4}$ mm.; depth, $\frac{3}{4}$ mm.

Horizon and locality.—Fine grey shales in the volcanic beds of the Coldbrook Group at Dugald Brook, Escasonie (C. B.), N. S.

ACROTHYRA (SIGNATA) SERA. Pl. XIII, figs. 3 *a–f.*

Valves corneous, thick, especially the ventral. General form orbicular, with the umbo of the ventral projecting.

Ventral valve nearly circular in outline, and with the back either straight, or slightly hollowed near the apex, and rounded down toward the front margin. The margin is somewhat straightened at the hinge, and there is a depressed pseudodeltidium, with a narrow striate area on each side. The area is at right angles to the base of the valve, which, when viewed from the side, has the margin somewhat arched up at the front and back. *Interior.*—This has near the hinge a thick rectangular callus, hollowed at the middle, with a depression that deepens towards the hinge; from this it is divided by a low transverse ridge, behind which is a pit leading to the foramen, which is just behind the umbo. On each side of the callus, two low ridges extend forward

at a wide angle, and limit the area occupied by the lateral muscle scars. The position of the central group of muscles in front of the callus is not clearly defined.

The dorsal valve is orbicular and the umbo depressed. Two broad obscure ridges radiate from the umbo to the sides of the valve. When viewed sidewise the valve is seen to be bent down both at the anterior and posterior ends. *Interior.*—The most prominent feature is the median septum, which is usually visible from one-sixth of the length of the valve from the back, to the middle of the valve. A pair of diverging grooves originate at the hinge line, and forward, towards the sides of the valve, divide off the space occupied by the impression made by the lateral muscles. Midway between these grooves and the median septum, are two faint vascular ridges. The margins of both valves are thickened and flattened.

Sculpture.—This consists of fine concentric ridges with smooth intervals between; the known surface is smooth and shining, but there are fragments of what appears to be an outer layer, with a dull, minutely granulated surface. The surface is often ridged with growth lines, especially toward the anterior margin.

Size.—Length and width of the valves equal, $2\frac{1}{2}$ mm. The depth of the ventral is $1\frac{1}{2}$ mm.; that of the dorsal, 1 mm.

Horizon and locality.—The Assise 1*c* of the Etcheminian at Dugald Brook, Escasonie (C. B.) N. S.

This differs from the type in the shorter and wider shell, upright hinge area, wider visceral callus, and straighter back of the ventral valve. From *A. signata prima* in the more regularly conical form of the ventral valve.

ACROTHYRA SIGNATA-TARDA. Pl. XIV, figs. 1 *a–d*.

Only the *ventral valve* known. This is tumid, with a broad low umbo, and convex on the median line. *Interior.*—Distinguished by two short prominent grooves that end abruptly, short of the end of the callus; the callus is narrow and has a low ridge along the middle; it ends $1\frac{1}{4}$ mm. from the hinge, and the two lateral grooves are about 1 mm. apart. Outside of the two grooves above named are low crescentic ridges in front of the lateral extensions of the hinge line, that enclose the scars of the lateral muscles.

The *dorsal valve* has not been separated from that of *Acrotreta papillata*, which occurs with it.

Sculpture.—This, on the lateral slopes of the valve, consists of fine, closely set ridges, visible only with a lens.

Size.—Length, 2½ mm.; width, 3 mm.; depth, 1½ mm.

Horizon and locality.—In the gray shales of E. 1 *c* and *d* at Dugald Brook, Escasonie, (C. B.) N. S. Common in the latter assise.

This mutation is distinguished from *Acrotreta papillata*, with which it is associated, by the form of the callus, etc., and from *Acrothyra signata* (typical) by its flatter callus and deeper and shorter lateral groves; the same characters distinguish it from *A. signata-prima* and *A. signata-sera.*

ACROTHYRA SIGNATA–ORTA. Pl. XIII, figs. 4 *a–f*.

This rather tumid form has an overhanging beak. *Ventral* valve broadly ovate, bluntly pointed, convex along the back, especially toward the front of the valve, where the curve becomes abrupt. *Interior*—A callus about three times as long as its width in front, extending from the beak one-third of the length of the valve, sometimes there is an apophysis in front of it, of equal width, sometimes an apparent extension of the callus, with a median ridge dividing it lengthwise. The callus usually has a transverse raised thread towards the posterior end, and sometimes another near the front. A faint, narrowly triangular hollow, divides the callus from the impression of the lateral muscles.

The dorsal valve is oblately orbicular in form, with inconspicuous umbo. The valve is somewhat depressed in the middle and toward the front. *Interior*—This part of the valve exhibits a median septum in the posterior quarter of the valve, and behind it two lateral septa, that fork from near the umbo; the place of the lateral muscles is faintly marked.

Sculpture.—Of fine concentric ridges, as with other forms of this species.

Size.—Length of ventral, 2 mm.; width, 1¾ mm.; height, 1 mm to 2 mm. Dorsal length, 1¾ mm.; width, 2 mm.; height, about ½ mm.

Horizon and locality.—Fine, greenish grey calciferous sandstone of E. 2 *c*. at Dugald Brook, Escasonie. Not rare.

This mutation shows a change in the direction of *A. proavia* described below, and of a higher horizon..

The ventral valves lie on their sides on the layers of the rock, but the dorsals are on edge.

ACROTHYRA PROAVIA. Pl. XIV, figs. 2 *a–g* and 3 *a–f*.

Acrotreta proavia, n. sp. Nat. Hist. Soc. N. B. Bull., Vol. iv, p. 203, pl. iii, figs. 2 *a* to *f*.

Shell substance calcareo-corneous. The thin outer crust sometimes wanting from corrosion, abrasion or absorption.

Ventral valve oblique-conical, with a prolonged beak. Cardinal area narrow, as is also the pseudo deltidium; in the pseudo deltidium near the apex is a small oval tubercle, between which and the apex, the foramen is supposed to be situated. The valves slope evenly down from the apex to the anterior and lateral margins. No good examples of the *interior* of this valve have been obtained; imperfect ones show two vascular lines enclosing a narrow visceral callus, and extending as far down from the apex on one side as the hinge area does on the other; the front margin exhibits on the interior a row of about ten radiating vascular ridges. This valve is often undulate with one, sometimes several strong grooves concentric to the umbo, marking periods of rest in the growth of the shell; corresponding ridges are found on the deltidial area.

The dorsal valve is round, and broadly rounded in front; the contour of the surface is varied by a moderate projection of the umbo behind, and by a slight flattening of the valve in front, giving the valve a round, slightly triangular relief. The *interior* has the impression of a pair of muscles in the umbo, whence a low ridge extends forward across the valve. Not infrequently the edges of this valve are flattened, and one or more grooves, concentric to the umbo, marking stages of growth, indent it.

Sculpture.—A strong lens reveals a series of concentric striæ on the surface on some examples of this shell, there being about 20 in the space of a millemetre. Between these ridges a still stronger magnifier (1 inch objective) shows a fine granulated surface with occasional rows of coarser granules, parallel to the concentric striæ. On the inner, chitinous surface there is a similar ornamentation, but less distinct than that on the surface of the outer layer.

Size.—Length of the ventral valve in the largest examples, 3 mm.; width, 2 mm. The dorsal valves in both diameters is 2 mm. Depth of the ventral valve from the beak 1½ mm.; that of the dorsal at the middle, ½ mm. A great majority of the valves are smaller and of the size given in the original description.

Horizon and locality.—In the Assise *e*, common (and less common in *d* where it is larger) of the upper Etcheminian; Dugald Brook, Escasonie, Cape Breton. Very thin shells are found in Assise *f*.

There is a good deal of variation in the form of the ventral valves of this species. The majority are of the dimensions given, but sometimes the width of the valve is equal to the longest diameter. Also the concentric furrows of growth are in some examples so profound as to give the ventral valve, when slightly distorted obliquely, the appearance of a minute Raphistoma.

This species differs from all others of the genus known to me, except *L. inflata* of the Protolenus fauna, in the overhanging apex, which in the typical form projects one-quarter beyond the base of the valve, but in the variety from Assise *f*, one-third beyond. As a result of their form, the ventral valves of this species, in place of standing erect like many of those of the genus Acrotreta, rest on the dorsal side, on the layers of the shale in which they are imbedded, and except for their strong convexity might be mistaken for those of a minute Lingulella. As they occur scattered over the layers of the shale they also strongly recall the ordinary aspect of the conical teeth of fishes, brilliant with black enamel.

No described species of Acrotreta is as small as the more abundant valves of this species, though *A. gemmula* of the Protolenus fauna approaches it in that respect.*

Sir William Dawson has called attention to the resemblance in structure between the shells of Hyolithidæ and the Brachiopoda, and has compared the ventral valve of a Brachiopod to the tube of a Hyolithes. Had Sir William been acquainted with this species he would have found it a good example for comparison. This will be seen if the ventral valve be so oriented, as to make the areal side correspond to the ventral side of a tube of Hyolithes. The dorsal valve with its round form and excentric umbo, with radiating lines, also resembles the operculum of a Hyolithes. A detailed comparison of this

* Trans. Roy. Soc. Can. Vol. xi, p 87, pl. xvi, figs 2 *a* to *d*.

species with certain Hyolithidæ has been made in an article contributed to the Royal Society of Canada (Trans. New. Ser. Vol. VII., Sec. IV. p. 93).

A study of layers of the shales of the horizon E. 3 *e.*, studded with the valves of this species, failed to reveal any ventral valves, showing clearly a thickened callus. For the relationship of this species we have therefore to depend on the forms *prima* and *crassa*, both of which possess a narrow thickened callus. These show that these three forms are of the same genus as *A. signata*, but of a different species, and reveal a series in the upper Etcheminian Fauna parallel to the *Signati* of the lower fauna; they are distinguished from the latter by their narrow visceral callus. The absence of a thickened callus in the typical form of *A. proavia* would seem to show that the pedicle in this form was slender and weak, and from the fact that this shell, above all its fellows, shows a perfect orientation in one direction, as imbedded in the shale, there is a presumption that the pedicle was also long, enabling the animal to swing in the currents of the sea in which it lived.

Often the ventral has an even slope along the back, but many old valves, especially long ones, show from two to three heavy concentric ridges, marking stages of growth of the shells.

Interior.—The *ventral valve* of this species has a quite small tubercle in front of the foramen. Two-fifths from the apex of the ventral valve there is a shallow depression on the interior surface, which, by analogy with mut. *prima* should mark the position of the central muscle scars. On each side of the shallow depression a shallow groove runs forward toward the front of the valve. Some examples show a median and two lateral septa in front of the shallow depression. Faint ridges, running forward on each side of the front slope of the ventral valve, may indicate the position of vascular trunks.

Interior.—The *dorsal valve* has inside, a median and two lateral ridges. On some valves the median ridge extends only so far as to divide the pits of the cardinal muscle; in others it extends to the middle of the valve. A pair of median pits are sometimes visible near the end of the median septum, one on each side of it.

ACROTHYRA PROAVIA-PRIMA, n. mut. Pl. XIV, figs. 4 *a–f*.

Ventral valve triangular-ovate, about twice as long as wide, prolonged into a long pointed beak, and rounded and bent down in front. *Interior.*—This exhibits a long narrowly tapering callus originating in the beak at the foramen; the callus is a third of the length of the valve, or more. In front of the callus is a shallow transverse depression, marking the position of the central group of muscles.

The *dorsal valve* is nearly circular, projecting at the back, where there is a somewhat low beak, and rounded down more at the front than the sides. *Interior.*—A median septum is visible, dividing the pits of the cardinal muscles. A shallow median ridge traverses the middle of the valve, which is flattened at each side near the hinge. The edges of both of the valves are flattened and thickened, also the apical third of the ventral valve is thicker than the middle of that valve.

Sculpture.—This consists of a very fine granulation, with frequent, thread-like, concentric ridges.

Size.—Ventral valve: length, 3 mm.; width, 2 mm.; height of the cardinal area, 2 mm. Dorsal valve, 2 mm. in each diameter; depth, ½ mm.

Horizon and locality.—E 3 *a* = base of the upper Etcheminian shale at Dugald Brook, Escasonie (C. B.), N. S. Frequent. In this rock the ventral valves of Acrothyra lie flat on the layers. Also a valve apparently of this form, 3 x 2 mm., from E. 3 *f.*, occurs at Gillis Brook, a branch of Indian Brook, Escasonie.

This mutation is distinguished from the type by its greater size and by the possession of a thickened callus.

ACROTHYRA PROAVIA-CRASSA, n. mut. Pl. XIV, figs. 5 *a–c*.

Only the *ventral valve* known. This is short, tumid and conical. *Interior.*—This possesses a narrow callus, four or five times as long as wide, and nearly a third of the length of the shell. At the front of the callus are two small oval scars divided by a faint septum. The callus is concave and extends back nearly to the beak.

Sculpture.—Some fragments of the surface which are preserved show fine, close set, concentric ridges.

Size.—Length, 2½ mm.; width, 2 mm.; height, 1½ mm.?

Horizon and locality.—Lower layers of the assise E. 3 *e.* at

Dugald Brook, Escasonie (C. B.), N. S. Also a doubtful ventral from E. 3 *f.* at Gillis, Indian Brook, Escasonie. Scarce.

This mutation is distinguished from the type and from mutation *prima* by its robust form, and from *proavia*, the type, also by the possession of a thickened callus. From the mutations and type of *A. signata* by the narrowness of its callus.

Of the two species of Acrothyra herein described, *signata* was found specially to characterize the lower half of the Lower Etcheminian fauna, being found most abundant in the middle measures of this set of beds. It is not, however, limited to these measures, but by mutations is sparingly represented in the upper part of this lower fauna.

Acrothyra proavia, on the contrary, has been found only in the Upper Fauna, and mostly in its higher part, where some layers are crowded with thousands of these little shells.

ACROTRETA. Kutorga.

While this genus appears as a contemporary of Acrothyra in the earliest Basal Cambrian, it seemingly lived on after the latter had passed away. But throughout the Coldbrook and lower Etcheminian measures, it is quite subordinate in numbers to Acrothyra, and we have not found it at all in the upper Etcheminian. Throughout the true Cambrian, in the Acadian Provinces, however, these conditions were reversed, for, with the doubtful exception of *Lingulella (Acrothyra ?) inflata* of the Protolenus fauna, an undoubted example of the genus Acrothyra is unknown to me above the Etcheminian horizon, and Acrotreta has full possession of the field.

ACROTRETA PAPILLATA, n. sp. Pl. XV, figs. 2 *a–f.*

(Calcareo-)corneous valves moderately arched, nearly orbicular.

Ventral valve with a moderately elevated umbo, one-fifth from the back of the valve; the back of the valve somewhat concave toward the umbo, but convex toward the front margin. There is a concave pseudo-deltidium, and the side slopes of the hinge area are convex. *Interior*—In this the visceral callus is short, sub-circular, and marked at the middle by a deep circular pit; at its sides, obscure, short, straight, diverging grooves are usually seen within the circular groove that surrounds it.

The dorsal valve is moderately arched, the slope being steepest toward the umbo, which is but slightly raised. On each side of the umbo flattened slopes run along the sides of the valve in the posterior half. There is a shallow median sinus on the back of the valve, which widens toward the front. *Interior*—Under the beak is a boss from which a median septum runs forward, that forks about a fifth of the length of the valve from the hinge line; from the space between the forks, at a third of the length of the valve from the hinge, the median septum reappears, widens, and terminates at a point nearly a third from the front of the valve. On each side of umbo are pits of the cardinal muscles, and outside these, in advance of them, and near the margin, are large scars of the lateral muscles.

The margins of both valves are flattened and thickened.

Sculpture.—This shell has a dull, minutely granulated surface, across which run narrow ridges concentric to the umbo, widely spaced in the middle of the shell, more closely arranged toward the margin, and closely crowded and narrow, on each side toward the hinge.

Size,—Ventral, $2\frac{1}{2}$ mm. long, $2\frac{1}{2}$ to 3 mm. wide, and $1\frac{1}{4}$ mm. high. Dorsal, as the ventral, except that the height is about $\frac{3}{4}$ mm.

Horizon and locality.—E. 1 *d*, the Gregwa shale of the Etcheminian at Dugald Brook, Escasonie, (C. B.) N. S. Common. It occurs also in Assise E 1 *c*.

VAR. Pl. XV, figs. 3 *a–c*.

In examples from Boundary Brook the form of the callus in the *interior* of the *ventral valve* varies from a perfectly circular elevation to one that is somewhat squared at the sides; the groove outside of the callus is sometimes indistinct. On each side of the foramen is sometimes a short, sharp furrow directed forward. In the *dorsal valve* the depressed posterior lateral slopes and the somewhat flattened anterior slope gives the valve a triangular appearance. The *interior* shows a pit at the hinge area, which is narrow, and thence a narrow median ridge runs nearly to the middle of the valve. An inconspicuous lateral branch is thrown off on each side of the median ridge.

ACROTRETA PAPELLATA-PRIMA, n. mut. Pl. XV, figs. 1 *a–c*.

Only the *ventral valve* of this form is known. This is wider than long, tumid, with the cardinal area vertical. *Interior.*—In this the

visceral callus is of a circular form, and only one-quarter of the length of the valves. Its ridge closely encircles a deep pit, which lies just in front of the foraminal opening, in the direction of which it becomes narrower and shallower. The traces of a pair of straight diverging grooves are discernable at the sides of the callus.

Sculpture.—This consists of minute concentric ridges, visible only with a strong lens.

Size.—Length, 2 mm.; breadth, 2½ mm.; depth, 1 mm.

Horizon and locality.—Fine gray shales in the volcanic beds at Dugald Brook, Escasonie (C. B.), N. S. Scarce.

The short callus distinguishes this species from *A. crothyra signata-prima* with which it occurs. The pit in this callus, though so short, is analogous to that of *A. signata*, so that in this earliest fauna these two types of umbonal muscle scar and groove were already differentiated.

ACROTRETA *c. f.* SOCIALIS. vonSeebach. Pl. XV, figs. 5 *a–k*.

c. f. Acrotreta socialis, v.Seeb., Zeitschr. der Deutsch. geol. Gesellschft., Vol. xvii, 1865, p. 341, pl. viii, *a*, figs. 1–4.

c. f. Acrotreta socialis, v.Seeb., G. Linnarsson, 1896, Brachiopods of Paradoxides Beds of Sweden, Bihang till K. Svenska vet. Akad-Handl. Bd. 3 No. 12, p. 16, Tafl. iii, figs. 32–34.

A small species with coarse surface characters and strong muscle scars.

Ventral valve moderately elevated, sub-circular in outline, somewhat flattened on the cardinal slope, where, in outline, it is slightly convex ; nearly straight on the anterior slope. *Interior*—At the back there are one or two faint grooves on the median part of the cardinal slope ; the foraminal boss is a wedge-shaped one with the point directed forward ; this is enclosed by two sub-parallel, deep, rounded pits, for attachment of muscles. Behind the foramen is the back of a ridge, similar to a crescent, that encloses the apical part of the shell behind, and laterally ; in the front half of the space thus enclosed is a faint outline of a visceral callus of a lozenge shape. The position of the vascular trunks is probably outside of the horns of the crescent, thence extending forward ; about a third or a quarter from the front of the shell is a crescentic row of short vascular grooves. In front of this row of grooves are one or two growth ridges, and the flattened border of the valve.

The *dorsal* valve is orbicular in outline; its height is less than half of that of the ventral. The valve is strongly arched in the posterior half, but somewhat flattened on the posterior lateral slopes. *Interior.*—This is marked by three strong radiating ridges in the posterior half of the valve; at the origin of these ridges are a pair of pits with a small tubercle in each, marking the position of the cardinal muscles. Of the three radiating ridges, the central is a narrow median ridge, with three sharp keels; for half of the length of the valve this ridge is prominent, but fades away in the anterior third of the valve; at the end of this ridge would be the scars of the anterior laterals ("j.") The lateral ridges are broader than the mesian one, but not so long; outside of them are the impressions of the lateral muscles.

Sculpture.—The roughness of the matrix prevent a good presentation of the surface characters of this species. Some examples of the ventral valve show fine concentric ridges, of which there are about ten in half the length of the anterior slope (*i. e.* about 10 to 1 mm.); the surface of these ridges appears to be granular.

Size.—The largest dorsal observed was 3 mm. across, but the greater number are not more than 2 mm. The full-grown ventral is about 2 mm. high, and the dorsal less than one.

Horizon and locality.—In gray flags of Div. 2*c* on the eastern slope of the valley of McNeil Brook, on the road to Trout Brook. Found in various attitudes in the sandy bed. The ventrals are both upright, inclined and lying on their sides in the layers. From this locality Mr. Fletcher has reported Obolella, a genus in which, at the time his report was written, many of these small brachiopods were included.

Linnarsson described very fully a species like this from the Paradoxides beds of Sweden.* He found it to range through the whole of the Paradoxides Zone. Our form belongs somewhat higher up.

From *A. Baileyi* of the (lower) Paradoxides beds in New Brunswick† this species is distinguished by its smaller size, narrow umbonal ridge to the ventral valve, higher cardinal area, and by the enclosing longitudinal pits that enclose the umbonal ridge. It differs from *A.*

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* Loc. cit.

† Trans. Roy. Soc. Can., Vol' iii, sec. iv, p. 86, pl. v, figs. 13, 13*a*, *b* and *c*.

gemmula of the Protolenus fauna‡ (see Pl. XV, figs. 4 *a–d*) in the sharp umbonal ridge, and by the strong lateral ridges of the dorsal valve. From *Acrothyra proavia* of the Etcheminian fauna § (see Pl. XIV, figs. 2 *a–g*) it is distinguished by the more central apex of the ventral valve, and by the prominent ridges of the interior of the dorsal valve, as well as by its larger size. From *A. gemma*, Bill. (Walcott)¶ it is distinct by its smaller size, less proportionate height of the ventral valve, its narrow umbonal boss and its more obscure cardinal area, also by a difference in the internal markings of the dorsal valve.

Acrotreta bisecta. Pl. xvi, Figs. 2*a* to *g*.

Occurs in the Upper Cambrain of Cape Breton (Dictyonema horizon) and is described in a previous number of this Bulletin (vol. iv., p. 275). It agrees best with *A. Baileyi*, but differs from all the others by the strong median septum of the dorsal valve.

Acrotreta. sp.

A species of this genus occurs in the sandstone of E 2*a* at Young's Point with *Lingulella Selwyni*. It is rare, and only a dorsal valve has been found.

Development of Acrotreta.

This is one of the most conservative of the genera of the Cambrian and Ordovician. Though its species occur at intervals at various horizons in this system, the uniformity of size and sculpturing are remarkable. The latter consists of fine concentric striation, only visible with a strong lens. The size did not increase more than about four-fold in area in the vast space of time included in the Cambrian and Ordovician Systems. Contrast this with Paradoxides, which increased in area an hundred fold in the first two sub-faunas of the Paradoxides Zone.

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‡ Trans. N. York Acad. Sci., xiv, p. 126, pl. v, fig. 5*a* to *d*.
§ Nat. Hist. Soc. N. B. Bull. xviii, Vol. iv, p. 206, pl. iii, figs. 2*a* to *f*.
¶ U. S. Geol. Surv. Bull. 30, p. 98, pl. viii, figs. 1, 1*a* and *b*.

The series of Acrotreta run in size about as follows:

SIZE AND FORM OF THE VENTRAL VALVE IN SPECIES OF ACROTRETA OF THE CAMBRIAN AND ORDOVICIAN.

HORIZON OR GROUP.	NAME AND REFERENCE.	IN MILLIMETRES. Length	Width.	Height.	Proportion of Width to Height
Coldbrook Group,	A. papillata—prima, Pl. xv, figs. 1a to c	2	2½	1¼	2.
Lower Etchminian,	A. papillata, Pl. xv, figs. 2a to f......	2½	3	1¼	2.4
Upper ? Etchminian,	A. gemma, (Bill.) Walcott*..........	2½	3	2	1.5
Protolenus Fauna,	A. gemmula,† Pl. xv, figs. 4a to d....	1½	1½	1	1.5
Lower Paradoxides,	A. Baileyi‡ Pl. xvi, figs. 1a to d......	3½	4	1 +	3. –
Upper Paradoxides,	A. socialis, v. Seebach,§	3	3	2	1.5
? Dolgelly,	A. gemma, (Bill.), Walcott*,.	3	3½	2½	1.4
Dolgelly,	A. bisecta,¶ Pl. xvi, 2a to g	3	3¼	2½	1.3
Tremadoc,	A. cf. socialis (Seeb), Brogger**.....	1½	2	1½	1.3
Tremadoc,	A. sipo, n. sp., Pl. xviii, figs. 1 and 2..				
Arenig,	A. gemma, Billings,††...............	1¾	2	2	1.
Llandello,	A. subconica, Kutorga,‡‡	4	4	4¾	.85
do.	A. Nicholsoni, Davidson,§§	4	4	4¼	.94
Etage D,	A. babel, Barrande,‖‖................	2	2½	2¼	1.1

It will be noticed that not only are the later species as a rule larger, but they are proportionately higher. Also we may observe that there were two lines along which there was a divergence in the relative height of the ventral valve. *A. Baileyi* had low umbones and approximated in form to Linnarssonia, a genus which, so far as has been observed, appeared in the Canadian Cambrian a little before it

The other line of development culminated in the high umboned species of the Ordovician faunas.

* Bull, U. S., Geol. Survey No. 30 p. 98.
† Trans. N. York, Acad. Sci.. No. XXVIII, p. 126.
‡ Trans. Roy, Soc , Can.. Vol. III., Sec. IV, p. 36.
§ Brachiopoda Paradox. Beds, Sweden, Linrs. p. 16.
¶ Nat. Hist. Soc., N. B., Bull, No. XIX, p. 275.
** Die Silurisch. Etagen 2und 3, p. 46.
†† Paleozoic Fossils, Vol. I, pt. 1, p. 216.
‡‡ Monog. Br. Brachiopoda. Vol. 1, pl, IX. Fischer, Conchyliologie p. 1266.
§§ Monog. Br. Brachiopoda, Vol I. pl. XVI, Vol. III, p. 388.
‖‖ Syst. Silur. Bohem, Vol. V, pl. 95.

For information regarding several European species of Acrotrata I am indebted to Mr. Gilbert Van Ingen, of the School of Mines, Columbia College, New York.

ACROTHELE Linnarsson.

ACROTHELE AVIA. Pl. xvi, Figs. 1*a* to *f* and 2*a* and *b*.

Acrothele avia, n. sp. Nat Hist. Soc. Bull., vol iv., p. 202, pl. iii., figs. *a* to *h*.

A rather large species with oblately oval valves and a thick horny shell.

Ventral valve somewhat concave in front of the apex. This valve has a triangular, somewhat convex, high area, including a narrow, slightly convex, pseudo deltidium, divided into two equal parts by an obscure central groove. There appears to be a foraminal opening at the slender pointed apex.

The *interior* of the ventral valve is marked by a shallow circular pit, on each side of the pedicle opening; and behind, at the margin, is a shallow triangular pit, resembling the pedicle groove of an Obolus In front of the pedicle opening is a strong oval tubercle, on each side of which extend the ridges that bound the oval centre of the visceral cavity. Four low vascular ridges extend forward from this oval area to the anterior margin of the valve. The parts of the interior of the shell, above described, are enclosed by an ox-bow shaped groove, resembling the impression of vascular trunks; these trunks have about four anterior branches, and each trunk extends nearly to the front of the valve. On the lateral slopes of the shell are three crescentic grooves, which may be accidental and due to pressure.

The dorsal valve is strongly bent down behind and in front. The umbo is slightly prominent, is appressed, and is close to the posterior margin. The sides of this valve have about a dozen radiating, branching, crenulated ridges, that extend to the margin.

The *interior* of the dorsal valve has a strong median septum, extending to the middle of the valve; at the end of this ridge is the central muscle. Scars of the latter are seen on each side of the broad end of the median ridge, near its end. On each side of the median ridge at the cardinal margin are two larger pairs of muscle scars.

From the posterior part of the shell several faint radiating ridges extend toward the front margin.

Sculpture.—The surface of the valves is marked by irregular, concentric, rounded ridges, that frequently anastomose; and the front of the ventral valve and the sides of the dorsal valve have a number of radiating ribs. The sculpture is very variable; on the central part of the dorsal it shows an irregular network of low, rounded ridges; on the sides of the valve these ridges are more regular in their course; and on the margins, especially of old shells they are stronger and more continuous. There is also much variation in the distinctness of the features of the interior, both of the dorsal and ventral valves, the smoother shells being thinner. There is no trace on the interior of the dorsal valve of the ridges on its lateral slopes.

Size.—Length 9 mm.; width 10 mm. or more. Depth of the two valves together 2 mm. or more. *Horizon and Locality.*—In assises *d* and *e* of the Upper Etcheminian (E. 3 *d* and *e*) Dugald Brook, Escasonie, N. S.

As the outer layer of this shell is thin and fragile, the strong inner layer is the one most commonly exposed, and might be thought the real surface. The outer surface has an ornate sculpturing, while that of the second layer is smoothed.

This species of Acrothele is distinct from all others by the long tubercle or callus in front of the pedicle opening. The ribs of the outer surface of the lateral slopes of the dorsal valve are peculiar to it. *A. Matthewi* and its varieties have no such ribs. *A. Matthewi-prima* has a granulate-latticed surface, but no lateral or anterior ribs. *A. Matthewi-costata* also has a granulated surface, and ribs on the front of the ventral, but none on the sides of the dorsal valve. The varieties of *A. Matthewi* also have the foramen nearer the cardinal margin than is the case with this species.

Examples of this species occurring in the Assise E. 3*d* differ from those of *A. abavia* occurring with it, in the thinner corroded valves, larger size and oblate form; they are doubtfully referred to this species, for the ventral valve is more concave in front of the umbo than are the typical shells occurring in Assise E. 3*e*. It does not flake at the middle layer of the shell as *A. abavia* of the same assise does.

In Assise E. 3*d* valves appear, which, by their oblate form and surface markings, may, without much doubt, be referred to this species. Not

only are they broader than the Acrotheles of the lower assises, but they are larger, some valves attaining 9½ mm. in width. An exterior of a ventral which is nearly one-half wider than long, and an interior of a dorsal about a third wider than its length, are figured.

In the examples from this horizon the *ventrals* show surface markings, hinge area and foramen; their interiors show crescentic grooves of the vascular trunks, and at the margin, prints of its branches. Some of the *dorsals* show the surface sculpture; others, which have the *interior* exposed, show median and lateral ridges, vascular lines, etc.

A. AVIA-PUTEIS. n. mut. Pl. xv, figs. 5 *a* and *b*.

This seems to be a variety of *A. avia*. It differs in the possession of a pair of pits, one of which lies on each side of the space between the foramen and the visceral callus, partly overlapping each. The visceral callus is quite short in this form and has but little prominence. The ridges on the surface of the valve are more regularly concentric than in the type, and more sharply cut; about ten are found in the space of one millemetre. The cardinal area is curved forward towards the top, and finely striated. The foramen is about a fifth of the length of the valve from the cardinal line, and the front of the callus about a third. Vascular trunks and branches are visible on the surface of the ventral valve as in the type. The dorsal valve does not sensibly differ from that of *A. avia*.

Size.—The largest valve seen was 8 mm. long, and about the same width.

Horizon and localily.—Found in the Bretonensis shale (E.3*d.*) at Gregwa Brook, Escasonie, Cape Breton. Frequent.

ACROTHELE ABAVIA. n. sp. Pl. xv, figs. 3*a* to *d*, and 4*a* and *b*.

Outlines of the valves nearly circular. Length of the hinge line less than a third of the diameter of the valve.

Ventral valve rather flat, with the umbo slightly raised. The umbo is about one-quarter of the length of the valve from the cardinal line. *Interior.*—In the examples known the horizon E.3*a.*, the interior is smoothly moulded, except along the front slope, where faint vascular grooves may be detected, but in those from E.3*b.* a visceral callus is faintly outlined, with a swelling on the middle; some valves here have

faint impressions of vascular trunks on each side of the callus running forward.

The *dorsal valve* has its greatest height near the middle, and has an appressed umbo, close to the hinge line ; the lateral margin, in the pos terior half are revolute. *Interior.*—A median septum starting near the hinge line, extends across the middle of the valve to nearly one-third from its front ; it is widest in the middle and fades away to a point in front. On each side of it is a vascular grove, the pair radi- ating from near the umbo and extending nearly to the front margin they are nearly as far apart at the front as half of the width of the valve. Another pair of such grooves, about half as far apart as these, are faintly impressed on each lateral slope of the valve. The visceral cavity is faintly marked out by striated lines in the posterior half of the valve, and has an irregular arched front, projecting near median septum towards the front of the valve. Faint vascular striæ are visible on the median area towards the front of the valve. Some examples from the horizon E.3*b* have a shorter septum, and show the position of the central and lateral muscles closer to the hinge line. These shells are more oblate.

Sculpture.—This is only known near the side of the valve, where it consists of fine, closely set, more or less tuberculated ridges, parallel to the margin.

Size.—Length and width equal, 7 mm. Depth of the ventral valve about $\frac{3}{4}$ of a millimetre ; that of the dorsal 1 mm.

Horizon and locality.—All the horizons from E. 3*a* to E. 3*e*, except E.3*d*, at Dugald Brook, Escasonie, N. S.

The Acrotheles of E.3*c* are much corroded, and do not show the characters well ; they are mostly moulds from which the shell has been exfoliated. One ventral shows well the hollow behind the hinge area, and the foramen.

Examples from the assises E.3*e*. have in the *ventral* valve quite a small tubercle in front of the foramen ; the visceral callus extends half of the length of the shell, and at each side in front are sometimes seen pits of the adductor muscles ; on each side of the callus a groove runs out toward the front margin. Some examples show a median and two lateral septa in front of the callus. Often the shell has an even surface to the margin, but frequently there are a few strong concentric ridges that mark stages of growth,

The *dorsal* valve of this species (from E.3*e*.) has inside, a median and two lateral ridges; on some valves the median ridge extends only so far as to divide the cardinal muscles; in others it extends to the middle of the valve. A strong pair of median pits are sometimes visible near the end of the median septum.

This is the oldest undoubted Acrothele detected in the Eopalæozoic rocks of Eastern Canada. Almost all show only the interior surface, or intermediate layers of the shell. One ventral has a corroded outside, with traces of concentric ridges.

ACROTHELE PROLES. n. sp. Pl. xvi, figs. 3*a* to *e*.

General form lenticular with the umbo of the ventral valve projecting.

The length and breadth of the valves of this species are sometimes equal, though usually the width is somewhat greater.

The *ventral valve* is convex on all the slopes, except close to the umbo, where it is slightly concave in front. The umbo is low, and is about one-seventh of the length of the valve from the hinge line, the area is about 1 mm. high, and the length of the hinge line nearly one-third of the width of the valve. *Interior.*—This has an obscurely lozenge shaped callus in front of the foramen, upon which at the posterior end is a small, more elevated portion. On each side of the callus is a pair of vascular ridges, marks of the advance of the central muscles. A pair of short ridges, near the hinge line, are of the nature of teeth outlining sockets for the articulation of the two valves. Faint curving ridges in the anterior part of the valve appear to be vascular trunks; these fork toward front, and show eight or nine ridges with corresponding depressions along the anterior margin.

The dorsal valve is more regularly lenticular, but more abruptly bent down behind than elsewhere, the umbo is depressed, and not easily recognized. Flattened valves exhibit costæ radiating from the umbo, but not reaching the margin. *Interior.*—This shows a strong, broad median septum extending nearly half of the length of the valve; at the front it fades away into fan-like ridges that rapidly sink to the level of the valve. On each side in the cavity of the valve, and extending nearly as far forward as the median septum and, diverging from it, is a pair of sharp vascular ridges. Outside of these, on the rounded edge of the valve at the ends of the cardinal line, are a pair

of elongated, flattened teeth, that articulate with the sockets in the ventral valve. The margins of the dorsal valve are broad and rolled backward at the edges.

Sculpture.—This consists of fine, regular concentric ridges that occasionally anastomose. There are about eight or ten ridges in the space of one millimetre, the ridges being more widely spaced toward the margin.

Size.—The largest valves seen was 12 mm. long; valves of 9 mm. are common, the height of each valve is about 1 mm.

Horizon and locality.—In the shales of E. 3*f.*, near the top of the Etcheminian at Dugald and Gillis' Brooks. Frequent.

This interesting species seems best represented in Europe by *A. coriacea* of Linnarsson, but that species is of the Paradoxides Zone, its umbo is further from the hinge line, and the cardinal features are different.

It will be noted that the supposed vascular trunks in this species, *Acrothele avia* and *Obolus (Palæobolus) Bretonensis* are far removed from the margins of the valves.

ACROTHELE, sp.

A species of this genus occurs in the flags of Division 2 (*b*?) of the St. John Group at a cutting on the Intercolonial R. R. at Long Island passage, St. Andrews Channel. The material is too imperfect to determine the species.

Notes on the following table.

It seems quite probable that when the Acrotheles that have been described from the Lower Paradoxides Beds are compared, some of the names may be found to be synomyms, there being five species accredited to the Band *c*. But it is to be remembered that there are two sub-zones in this band, showing considerable differences in the fauna. To the lower sub-zone of Paradoxides lamellatus (*cf.* Œlandicus) *A. granulata* and *A. cf. coriacea* are to be assigned, and to the higher or sub-zone of *P. eteminicus* and *Conocoryphe Matthewi*, the other three.

As Mr. Walcott's species are referred simply to Lower Cambrian, one cannot compare them closely with the others; but it seems pos-

(Continued at page 404.)

DISTRIBUTION OF ACROTHELE IN THE

	NAME OF SPECIES AND REFERENCE.	Upper Etcheminian. Faunal Sub-zones.					
		a	b	c	d	e	f
1	Acrothele abavia, n. sp..	×	×	×		×	
2	A. ——— avia, mut. puteis, n. m.				×		
3	A. ——— avia*				×	×	
4	A. ——— proles, n. sp.						×
5	A. ——— decipiens, Walcott ‖.				L C		
6	A. ——— Matthewi, mut. prima†.						
7	A. ——— ——— mut. lata†.						
8	A. ——— Gamagei, Hobbs.						
9	A. ——— intermedia, Linnarsson¶.						
10	A. ——— granulata, Linnarsson++.						
11	A. ——— c. f. coriacea, sp. ined.						
12	A. ——— Bohemica, Barrande						
13	A. ——— Matthewi, Hartt*.						
14	A. ——— coriacea, Linnarsson††						
15	A. ——— subsidua, White‡‡.				L C		
16	A. ——— incohans, Barrande‡‡.						

* Bull. Nat. Hist. Soc. N. Bruns'k, vol. iv, p. 202, pl. iii, figs. 1*a* to *h*, 1899.
† Trans. Roy. Soc. Can., vol. iii, sec. iv, p. 39, pl. v, figs, 16, 16*a*, 17, 17*a*, 1885.
‡ Palæont. Camb. Terranes, Boston Basin. A. W. Grabau, p. 615, pl. 31, figs. 1*a* to *d*, 1900.
++ Brachiopoda of Paradoxides Beds of Sweden, p. 24, pl. iv, fig. 51, 1876.
‖ Proc. U, S, Nat. Mus. No. xix, p. 716, ld. 60, fig. 2, 1897.

CAMBRIAN ROCKS OF EASTERN CANADA, ETC.

ST. JOHN GROUP.												
Acadian. Division 1.				Johannian. Division 2.			Bretonian. Division 3.					
Faunal Zones.							Parabolina.	Peltura.	Dictyonema Asaphellus.	Tetragraptus.		
Protolenus		Paradoxides.										
a	*b*	*c*	*d*	*a*	*b*	*c*	*a*	*b*	*c*	*d*	*e*	
....	....	....	....	....	....	....	....	....	....	....	..	1
....	....	....	....	....	....	....	....	....	....	....	..	2
....	....	....	....	....	....	....	....	....	....	....	..	3
....	....	....	....	....	....	....	....	....	....	....	..	4
....	....	....	....	....	....	....	....	....	....	....	..	5
....	×	....	....	....	....	....	....	....	....	....	..	6
....	×	....	....	....	....	....	....	....	....	....	..	7
....	....	×	....	....	....	....	....	....	....	....	..	8
....	....	×	....	....	....	....	....	....	....	....	..	9
....	....	×	....	....	....	....	....	....	....	....	..	10
....	....	×	....	....	....	....	....	....	....	....	..	11
....	....	....	×	....	....	....	....	....	....	....	..	12
....	....	×	×	....	....	....	....	....	....	....	..	13
....	....	....	....	....	×	....	....	....	....	....	..	14
....	....	....	....	....	....	....	....	×	....	....	..	15
....	....	....	....	....	....	....	....	....	×	....	..	16

¶ Ibidem, p. 21, pl. iv, figs. 44 to 48.

*⁎ Acadian Geology, Dawson, London, p. 644, fig. 221, 1868.

†† Geog. and Geolg. Expl. West 100 Merid., vol iv, pt. 1, p. 34, pl. i. figs. 3*a* to *d*, 1875.

‡‡ Fauna med Conocoryphe exsulens, Stockholm, p. 25, taf. iii, figs. 40–44, 1879,

‡‡ Faune Silur. de Hof, p. 102, figs. 74 and 75, 1868.

(Continued from page 401.)

sible that the one referred to *A. subsidua* may be some other species, as it occurs with a different fauna than that of the original form, and apparently, should be much older.

I have ventured to assign White's *A. subsidua* to the Peltura Zone, because it appears to be the same with a species which occurs in the Mt. Stephen Fauna; this fauna contains an Ogygia and an Olenoides with other forms which appear to indicate this as the lowest horizon to which it should be assigned. White's species is said by Director Walcott to occur with Asaphiscus and Olenoides, which also appear to be Upper Cambrian forms.*

Near the same horizon, or perhaps a little higher would come Barrande's *A. incohans* which occurs in the "Fauna of Hof" equivalent to the Tremadoc Fauna.

Among the Acrotheles there are several types of sculpturing of the surface of the valves. The most characteristic is that of fine, short, irregular wavy ridges, such as are found in *A. Matthewi* and *A. granulata.* Another type is represented in *A. proles*, *A. gamagei* and *A. cf. coriacea* wherein the ridges become more regularly concentric; the valves in this group are larger, and the ventral less selliform than in the preceeding one. White's description of *A. subsidua* would indicate that there is a third style of ornamentation in the latter species, in which the surface is papillose, yet with concentric lines of growth.

From the time of its sudden appearance in the base of the Upper Etcheminian group, Acrothele continues to be common until we pass the Lower Paradoxides beds; from this point upward they are rarely met with in Eastern Canada. It is thus more limited in range than Acrotreta which extends up into the Ordovician. Its range also differs from that of Acrothyra, which is a common genus in the Lower Etcheminian, can be found even as far down as the Coldbrook, and also is present with Acrothele in the Upper Etcheminian, but hardly invades the Protolenus fauna; where, as well as in the Lower Paradoxides beds, shells of Acrothele are common.

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* Bull. U. S. Geol. Surv. No. 30, p. 40.

(B) THE TREMADOC FAUNA.

In this fauna one enters upon the debatable ground between Cambrian and Ordovician. In the Edition of Dana's Geology, 1875, this group was classed as Silurian (*i. e.* Ordovician). In the later edition (1896) it is transferred to the Cambrian. Prof. Jas. Hall referred species of this fauna from the Sandstones of the Mississippi valley to the Potsdam (therefore Cambrian) in 1863 ? Director Walcott has referred strata in the west of America and at Saratoga, N. Y., holding this fauna to the Potsdam or Upper Cambrian.

But in Europe the consensus of opinion (omitting Great Britian) places this fauna in the Ordovician or Lower Silurian. Lindstrœm says that in Sweden not one species passes from the Cambrian to the Ceratopyge Fauna (*i. e.* the Tremadoc) while nineteen species pass from the Ordovician to the Silurian (Upper). Four species, however, are recorded as passing in Wales from the Lingula Flags to the Tremadoc Group.* Elsewhere it is stated that 6 out of 37 species of crustacea pass from the Tremadoc to the Arenig in Wales.† So that it is difficult to draw a line of absolute division between Cambrian and Ordovician either above or below the Tremadoc.

On the whole it seems better to hold to the prevalent English opinion which places the line of the division above the Tremadoc, notwithstanding the conditions that prevailed in Northern Europe, and notwithstanding the fact that new and important genera of crustaceans appeared in the Tremadoc slates.

To adopt the line drawn by the palæontologists of Scandinavia and Germany would make necessary a revision of the Cambrian geology of America, whereby large areas and extensive faunas that have been classed as Cambrian would of necessity be transferred to the Ordovician, or Lower Silurian.

Further, it may be inferred that this hiatus in the faunas will be bridged over by the discovery of connecting faunas in the strata of some other region than that of Europe. The Mount Stephen fauna, for instance, in British Columbia, associates genera of Ffestiniog, Dolgelly and Arenig types, and generally in the Rocky Mountain region there is a blending of Cambrian and Ordovician types. For these reasons it seems undesirable to abandon the old classification which drew the

* Mem. Geol. Surv. G. B., vol. iii, p. 365, etc.

† Ibid. p. 353.

dividing line at the base of the Arenig, and made the appearance of the Arenig graptolites the starting point of a new system.

The beds from which this fauna was taken appear in outcrops along the left bank of McLeod Brook, in Boisdale, Cape Breton, N. S., the best locality being about an eighth of a mile below the bridge that crosses that stream in McMullin Settlement. The rock is a soft, fine-grained, dark gray shale, not very different in appearance from that which, on the opposite side of the valley of McLeod Brook, carries the Dictyônema fauna. The rock easily softens when exposed to the weather, but is compact and firm lower down. No reference is given to "locality" in the following descriptions, as all come from McLeod Brook. The classes represented here are Brachiopoda, Lamellibranchiata, Gasteropoda, Vermes and Crustacea.

ACROTRETA SIPO. n. sp. Pl. XVIII, figs. 1 and 2.

A small species with somewhat overhanging umbo.

Ventral valves nearly as high as long. Umbo projecting behind the cardinal line, somewhat bluntly pointed, (some valves are trumpet shaped toward the margin) and a little broader than long. *Interior.* The foramen passes outward through a short siphon which is attached to the dorsal side of the valve; on each side of it are traces of lateral septa; in front of it is the faint impression of a callus which extends one-third of the distance to the anterior margin.

The *dorsal valve* is transversely oval, and arched from hinge to front, more strongly near the hinge; the lateral edges are flattened, especially toward the hinge. *Interior*—This shows traces of scars of lateral (?) muscles on each side of the umbo, and of a pair of central muscles near the middle of the valve. A distinct, though low, median septum crosses the valve nearly to the front margin.

Sculpture.—No concentric striæ were observed on this species, but the surface of the valves is minutely granulated.

Size.—The largest ventral observed had a size at the orifice of 3 x 3 mm., and others a height of 2½ mm. A dorsal was 2¾ x 3½ mm.; height ¾ of a mm.

The siphon is seldom preserved.

Three quarters of the ventral valves collected stand vertically in the mud in which they were entombed.

This curious little shell seems to throw light on the function of the callus in Acrothyra and Acrotreta. In ordinary species of Acrotreta the strong thickened ring around the foramen, within the shell, only needs to be raised still further to produce a siphon. And the siphon in this species, attached as it is to the dorsal side, holds the position of the callus in Acrothyra.

This must be near in age to *Acrotreta gemma* of Billing's, than which it is a little larger, but as we do not know anything of the interior of Billing's species (which belongs to the Arenig horizon) we do not use his name.

LEPTOBOLUS cf. LINGULOIDES.

A small linguloid shell is not rare in this shale. As in others of this genus, the umbo of the ventral is weak and short, and so the two valves are not easily distinguishable. Owing to the thinness of the valves the internal features are only faintly indicated. The ventral shows two lateral ridges diverging from the umbo, and a callus is obscurely indicated; one example shows a trace of a vascular trunk on one side. The dorsal has an obscure medium septum extending to the middle of the valve.

Sculpture.—A very fine concentric striation is visible on some valves.

Size.—Usual length, 3 mm.; (largest, $3\frac{1}{2}$ mm.); width, $2\frac{1}{4}$ mm.; (largest, $2\frac{3}{4}$ mm.)

This species is nearly as large as *Lingulella linguloides* of the Lower Paradoxides beds near St. John, a species which we would also refer to Leptobolus. The outline also is similar, but the umbo of the ventral is weaker; this and the smaller size may be due to a more pelagic habitat.

LINGULELLA cf. DAVISII, McCOY.

Examples of a Linguella, which though smaller than the above species of the Lingula Flags and Tremadoc slates of Britain, has the same general form, are found in the Cape Breton beds. It has the nearly straight base and sub-parallel sides of McCoy's species. The dorsal valve has on the interior a median septum two-fifths of its length,

and the whole interior, especially towards the umbo, is marked with scattered pits.

Sculpture.—Externally this shell has fine concentric ridges, which are crossed by very fine radiating striæ. The middle third is marked by numerous fine radiating vascular lines, and the lateral borders are flattened at the sides.

Size.—Length 10½ mm.; width 9 mm. Infrequent.

LINGULELLA cf. LEPIS.

Another Lingulella, a smaller species, occurs with preceding. It has a similar but proportionately coarser concentric striation; between the ridges it is marked with a fine granulation; the outline is more regularly rounded than that of the preceding species. It appears to agree with Salter's species as regards the form and striation, though it is smaller, being only half the length. The interior markings are not known.

Size.—Length, 6 mm.; width, 5 mm.

MODIOLOPSIS (?) cf. SOLVENSIS, Hicks.

Long-ovate, elevated toward the umbo and carrying its fullness towards the lower posterior end of the valves.

The umbo is near the anterior end, and there is a small, transversely elongated scar just in front of it.

Sculpture.—The bad condition of the surface leaves this doubtful for most of the surface, but there are faint concentric striations toward the lower margin and the posterior end. Only two examples known.

Size.—Length 4¼ mm.; width 2½ mm.

This species resembles that above cited, but lacks the strong ridge extending backward from the umbo. It is also only half of its length.

BELLEROPHON INSULÆ, n. sp. Pl. XVIII, fig. 3.

A small thin species, having about three whorls, of which outer is enlarged and more than twice the height of the others; it is emarginate

on the ventral side, and shows no keel; it has from two to three concentric growth ridges in the outer half of the last whorl.

Sculpture.—The outer whorl shows a very fine concentric striation, visible only with a strong lens.

Size.—Height across the whorls, 7 mm.; width across the shell from the emargination of the aperture at the ventral side, to the dorsum opposite, 4 mm.; width across the aperture from ventral to dorsal, 4½ mm.

Dr. Henry Hicks' species (*B. Ramsayensis*), which is about the size of this one, may be con-specific with it, but the Welsh specimens are too much distorted to be used for satisfactory comparison, and his description is brief.*

Prof. W. C. Brœgger figures a species (*Bellerophon Norvegicus*), from a corresponding horizon in Norway.† It is a little smaller, the outer whorl expands more rapidly and is free for half of its length; it is not deeply notched like our species; though differing in these respects, it has a striation similar to the Canadian species, only in place of being sharply curved back at the dorsum, the striæ curve forward in crossing that line.

BELLEROPHON BRETONENSIS, n. sp. Pl. XVIII, 4*a–d*.

Shell of about two or more whorls, the outer whorl large and moderately expanded. Orifice somewhat enlarged and strongly emarginate on the dorsal side by a sharp V-shaped sinus. Sides of the opening strongly arched upward between the dorsal and ventral sides. No distinct keel.

Sculpture.— The surface is diversified with numerous rounded ridges concentric to the umbo, with flat spaces between; there is a sharp, narrow furrow along the crest of each ridge; the ridges near the orifice are sharper and more crowded than farther back on the whorl; here there are about three in the space of 2 mm., but towards the mouth about four. The fine sculpturing of the surface appears to be a minute granulation.

Size.—Length from the inner part of the last whorl to the lateral edge of the lip, 20 mm. Width across the shell from the dorsum to the inner part of the last whorl, 12 mm.

* Quart. Jour. Geol. Soc., London, vol. xxix, No. 113, p. 50, pl. iii, figs. 30-32.

† Memoir cited, p. 53, pl. x, figs. 15, 15*a*, 15*b*.

The characters of this shell are obscured by flattening in the shale The umbo appears to be excentric, and it resembles *B. Œlerti*, Bergeron, of the Lower Ordovician of the Montaigne Noir in Southern France,* but has fewer whorls. Similarly to that species, the ridges on the shell are more distant from each other on the upper part of the main whorl than towards the aperture. I could not detect any flattened ridge along the keel of the dorsum.

This shell is distinct from *B. arfonensis* Salter by the sharp angulation at the dorsal line, and the striæ that cross it are angulated, not arched.

BELLEROPHON SEMISCULPTUS, n. sp. Pl. XVIII, figs. 5.

Only the last whorl known. This is free from the inner part of the coil. The proximal part is smooth with faint concentric undulations of growth.

The lines of growth arch backward toward both ventral and dorsal side, and at the dorsum there is an elevated flattened keel, separated from the lateral slopes by a slight furrow; the striæ that run backwards to this keel traverse it at right angles.

Sculpture.—The outer two-thirds of the whorl is marked by sharp-edged, concentric ridges of growth; at first there are about four in the space of a millimetre, then they become more distant with flattened spaces between, and toward the orifice of the shell there are about two ridges in the same space. Between the ridges, and on the smooth part of the whorl, the surface of the shell is minutely granulated.

Size.—Only one example is known, which is 7 mm. across from the back of the whorl to the mouth, and 6 mm. across from the ventral side of the mouth to the dorsal keel.

This species resembles *B. hippopus*, Salter, of the Arenig horizon in Wales. It differs in its smaller size and in the very regular ridges of growth; there being no alternation of weak and strong ridges. From *B. arfonensis*, of the same author, it differs in the raised keel in place of a depressed band along the dorsum.

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*Etude geologique du Massif Ancien situé au sud du Plateau Central, J. Bergeron, Paris, 1889, p. 348, pl. iv, figs. 10 and 11.

UROTHECA, sp., Pl. XVIII. fig. 6.

A thin chitinous tube seemingly of this genus occurs sparingly. It is thickened along one side and is marked by very minute longitudinal striæ.

PARABOLINELLA QUADRATA, n. sp. Pl. XVIII, fig. 7.

Middle piece of the head shield subtrapezoidal in outline. Anterior marginal fold narrow; width of the front area of the cheek, one-fourth of the length of the glabella. Glabella quadrate in front, and as wide there as its length, but considerably narrower at the posterior furrow. Posterior and second furrow directed backward, and deeply impressed in the outer third, but not reaching the margin of the glabella. Eyelobe slightly elevated, extending opposite the two anterior furrows of the glabella; ocular fillet broad and indistinct. Fixed cheek triangular, about as wide behind as the length of the dorsal suture behind the eyelobe. The posterior marginal furrow is faintly marked. The dorsal suture arches outward in front of the eyelobe, and behind it goes direct backward and outward to the posterior margin, and in that part is nearly half as long again as the chord of the eyelobe and anterior part of the suture together.

The pleuræ are long and narrow, and have a sharp, deep furrow, which is nearest the posterior margin; they are sharply bent, and pointed at the ends. The ring is pushed up in the middle into a pseudo-tubercle, such as is common on the occipital ring of species of this genus.

Sculpture.—A row of faintly marked tubercle-like swellings are found along the bottom of the anterior marginal furrow. The middle piece of the head-shield in all its parts appears smooth, except for a minute punctation.

Size.—Middle piece of the head-shield 25 mm. long. It is 25 mm wide at the anterior and about 40 at the posterior end.

This species is near *Parabolinella limitis* of Brœgger. It differs in its longer and more quadrate glabella. The fixed cheek also is longer and the eyelobe less prominent. Apparently also it is a larger species.

From *P. rugosa* of the same author it is distinguished by its more quadrate glabella and by a different arrangement of the glabellar furrows. It resembles this species in the possession of a comparatively

wide area in front of the glabella. The glabella, so wide in front (one-seventh wider than at the posterior lobe), recalls that of *Ceratopyge forficula*, Sars., of a similar horizon in Sweden.*

PARABOLINELLA cf. LIMITIS, Brœg.

The middle piece of the head-shield of a young individual which, by its form, agrees with the figures of this species, given by Professor Brœgger,† was found in these beds. Only one example was met with. The size of the shield is $2\frac{1}{2}$x 4 + mm. The interior of the shield shows three pairs of furrows, a strong ocular fillet, and a well-marked eyelobe.

TRIARTHRUS BELLI, n. sp. Pl. XVIII, fig. 8.

Only the middle piece of the head-shield is known; this is subquadrate, with narrow cheeks and anterior margin.

There are traces of a very narrow anterior marginal fold, and behind it a narrow convex anterior area of the cheeks. The *glabella* is quadrate, rounded in front, and bears three pairs of furrows, which are progressively less bent backward from the back to the front pair, though the two posterior pairs are already parallel; the anterior pair are quite faint, and more strongly arched than the others. The glabella is somewhat keeled along the axial line. The *fixed cheek* is long and quite narrow, and is separated from the front area by a shallow furrow; at the eyelobe it is about one-third of the width of the glabella, and at the back about one-half. The eyelobe is long, narrow and obscure. The posterior marginal fold is narrow but prominent. The occipital ring is bent forward at the ends, and has a tubercle on the axial line.

Sculpture.—This species has a smooth test, but under a small lens shows a somewhat uneven surface.

Size.—Only one example known; in this the middle piece of the head is 6 mm. long and 10 mm. wide at the back. Scarce.

This species is clearly distinct from *T. Beckii* Green by its narrower cheek and wider space between the sutures in front. It resembles more closely *T. Angelini* Linrs, but it differs from the type of that

* Die Silurischen Etagen, 2 und 3, p. 14, tab. iii, fig. 3.
† Die Silur. Etag. 2 und 3, p. 102, tab. iii, figs. 2 and 4.

species as figured by Linnarrsson in the wider frontal area of the cheeks and its convex front margin; also in possessing three pairs of furrows, etc. From the Norwegian form, referred to this species by Brøgger, it differs in its narrower glabella, rounded front, and in having three pairs of furrows, though the third one is faint; the anterior area of the fixed cheek is wider, and is separated from the rest of that cheek by a shallow furrow; it is, however, nearer this form than to any other known to me.

Billings does not describe *T. Fischeri*, except by contrast with other species (Upper Ordovician chiefly), but from his figure of that species, the Cape Breton form differs in the posterior marginal fold, which is not turned forward, like *T. Fischeri*. It also differs from that species in having an anterior buccal area and in the absence of pits on the front of the glabella.*

I refer this species to Triarthrus rather than Parabolinella because of the narrow fixed cheeks, the long, backward-turned eyelobes and the regular, straight furrows on the glabella.

Angelina ? sp. ? Pl. XVIII, fig. 9.

While we have no adult of this genus from the Tremadoc of Cape Breton, there is a young larval shield which seems to agree reasonably well with the characters of this genus by its suture and general outline. Only the head-shield has been preserved. This is narrow, as are all its parts. The eyelobes are curved and linear, starting from near the front of the glabella in a heavy ocular fillet, the eyelobes are placed about the middle of the cheek. The movable cheeks have extended spines, and are cut off in front by the curving suture. The glabella is ridged along the middle, and has traces of three pairs of faintly marked furrows. The occipital ring is narrow and weak.

Sculpture.—The surface appears smooth.

Size.—Length of this larval headshield, 5 mm. (or to the end of the spines 8 mm.); width, 7 mm.

Asaphellus Homfrayi, var. Pl. XVIII, figs. 10*a–e*.

Salter's description of this species is as follows:

"Asaphus (Isotelus) long-oval, gently convex, having the head subangulate in front, and having short [genal] spines. Facial suture

* Palæoz. Fossils, vol. i, p. 291, fig. 280.

within the margin. Eyes submedian [near the mid-length of the shield], small. Pygidial axis long, somewhat prominent at the apex. It is three inches long and one and a half broad."

The addition to this description in Salter's trilobites is as follows:

"The head is more than a third of the whole length, and longer than the thorax, which in its turn, is *longer** than the caudal shield. The head is semi-oval, rather pointed in front, and has *very short* posterior spines; it is broadly depressed around the margin. The glabella portion is scarcely marked out; the eyes are placed nearly half-way up the head; they are small (two lines long), the facial sutures curving out boldly beneath them, and cutting the posterior margin more than half way out from the axis.

Above the eye they form a narrow ogive, and nearly follow the front margin. On the underside of the head the vertical furrow on the epistome shows distinctly through the cast. The labrum [hypostome] is imperfect, but exhibits a strong marginal groove, and two small lateral furrows.

The body rings have the axis as broad as the sides, and moderately convex. The pleuræ are flat as far as the fulcrum, truncate at their ends, and have but a slight groove, which reaches two-thirds of the length. The fulcrum is at one-third in front, and less than half way out in the middle pleuræ.

The caudal axis extends three-fourths down the smooth tail, very indistinctly marked above, but in some specimens crossed by several faint rings, and is always prominent at the tip."

The Cape Breton form, by its hypostome, is clearly within Callaway's genus Asaphellus. Allowing for the distortion of the type species, figured by Salter, it is quite as large.

Certain features, not mentioned by Salter, are characteristic of the Cape Breton form. The glabella is somewhat ridged along the axial line, and its margins more distinct. About one-fifth of the length of the head shield from the back there is a slight but distant prominence (scarcely a tubercle) on the axial line; a fairly marked tubercle is also found on the median line of the axis of the pygidium, at the back of the first ring, and faint traces of similar prominences on succeeding rings.

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* The italics are inserted to mark points of difference from the Canadian variety.

The genal spines are not as short as Salter's description indícates, for the points are opposite the fourth segment of the throax; the length of the movable cheek and spine, behind the facial suture, is just equal in length to the part of the latter behind the eyelobe.

The eyelobes are variable in position; in the type figured they are just half way between the front and back of the shield; in examples of the narrow form they are, proportionately, further back; and in both forms the width of the middle piece in front is considerably less than at the eyelobes.

In the broad form, the headshield, thorax and pygidium are each of about equal length; others have the pygidium shorter than the thorax by the width of one joint. In the narrow form examples occur in which the pygidium is longer than the thorax. The pygidium has more numerous somites than *A. Homfrayi* as figured by Salter.* From *A. affinis* McCoy (Ibid) it differs in having the middle piece narrower in front, and the glabella and axis of the pygidium more markedly elevated.

Young individuals have the pygidium proportionately shorter and wider; one of about 15 mm. in length has a pygidium equal in length to only six rings of the thorax. The thoracic ring is narrow, for one is equal in length to the breadth five rings.

HYPOSTOME.

This for *A. Homfrayi* seems very imperfectly known. A good example of the Cape Breton variety has the following characters:

Hypostome 16 x 17 mm. main lobe 11 x 11. No anterior wing or doubleur attachment was observed.

Nearly circular, though wider towards the back than the front. It has a moderately arched oval body, with a broad convex border, wider towards the back. The main body of the hypostome is divided by a pair of diagonal furrows that impress each outward third about two-thirds from the front. Immediately behind these furrows are the maculæ, sharp, narrow ridges, raised above the general level of the hypostome; no ocular facets are visible, but there are several small, obscure pits along the ridge. The macula of the hypostome is opposite the eyelobe of the cephalic shield, but is nearer the axial line of the body. The furrow within the border is depressed at the back and

* Monograph British Trilobites, p. 165, pl. 24, figs. 6-12.

bordered by a narrow upturned flange, but there is no emargination, nor does the border project backward in a fork. The hypostome is highest in the middle of the main lobe, and the convex border is bent down in the middle, where it is broadest.

Development.—Young; 2 x 1½ mm.

This form is interesting as a connecting link between several genera of the Asaphidæ. It may be said to antedate the development of the generic characters.

At this stage the carapace had no flattened borders, and the head shield especially was strongly bent down in front and at the sides. The back of the glabella is very distinctly marked out, and here the head-shield is strongly trilobed. About the middle, on the inside of the shield, a flaring ridge runs out on each side from the glabella, and fades away on the surface of the test, that appears to be the back part of the eyelobe. At this stage no movable cheek had been detached, but the genal corner of the shield is somewhat extended into a short point. There are indications of several somites in the head shield; first the neck ring and posterior marginal fold, then a pair of somites indicated by incipient furrows on the sides of the glabella, then the ocular segment.

The thorax, at this stage, possessed two joints, with rounded rings and pleuræ.

In the pygidium, the neopygidium and protopygidium* are distinct; the former has three rings as strongly marked off as those of the thorax, the protopygidium has the same number of obscure somites.

In this larval form, which in development is close to the unsegmented larva, the outline of the headshield distinctly recalls the adult in Illænus and Dysplanus, but the strongly segmented pygidium has an even more generalized meaning.

Young 6 x 5 mm.

This moult already possesses many features of the adult.

The flattened borders are obvious on both shells, and the head-shield is broken up into the three principal pieces. The movable cheeks have heavy genal spines, and the course of the suture is functionally that of the adult. The slipping of the cheeks in this example has obscured the eyelobe, which, however, appears to be not far from

* Trans. Roy. Soc. Can. 2nd Ser., vol. iv, sec. iv, p. 145., lines 24, 27.

the glabella. The glabella, though slightly marked elsewhere, is marked off in front by a slope to the flattened margin.

The thorax now has five joints, and the pleuræ has grooves and facets like the adult.

The pygidium has about the same number of segment as in the younger shield, but those of the neopygidium are less prominent than in the younger moult; they are, however, still discernable on the side-lobes, as well as on the rachis. In this, while not agreeing with the genus Asaphellus, they recall many others of the Asaphidæ.

Note on the Young of Asaphellus Homfrayi.

Since writing the above in regard to the young of *Asaphellus Homfrayi* the writer has consulted Dr. Callaway's article on the fauna of the Shinton Shales,* and was at once struck with the resemblance between the youngest form here described, and *Conophrys Salopiensis*, and it is clear that the latter is a later stage or development of the former.

There is no question that in the Canadian form three rings, of the five that are strongly marked, are still a part of the pygidium; but if they were *free* rings there would be a remarkably close assimilation to Conophrys, the difference being only in the greater number of rings in the thorax of this genius. Looked upon as a developmental stage of Asaphellus this difference is to be expected, as our form is smaller than *Conophrys Salopiensis.*

The differences in the headshield are also of a kind that naturally follow from the two being different stages of development. Dr. Callaway shows the front lobe of the glabella as much more distinct than that of the Canadian form, though he speaks of it as being "hardly distinguishable from the front of the head;" in the Canadian form this lobe is barely discernable, except at the sides of the glabella. Again he speaks of the neck furrow being "deep," whereas in the Canadian form it cannot be discerned, and the lateral furrows are fainter and more embryo-like. *Conophrys Salopiensis* therefore may very well stand as a developmental stage of *A. Homfrayi*, somewhat more advanced than the youngest form ascribed to this species from the

* Quart. Jour. Geol. Soc. London, vol. xxxiii, p. 652.

Canadian beds. The development of one genus from another in the earliest larval stages is shown in the observations on the development of *Anomocare stenotoides* from an Olenus-like (Acantholenus) larva.*

On the other hand, those studies show that Conophrys or rather Shumardia may be a valid genus, arrested in the phylum from which Asaphellus and Asaphus were elaborated; if so, however, we should be able to find it in faunas from which these genera are absent. Nevertheless it is quite possible that it might be absent from faunas which have the later Asaphi, if the Shumardia stage were passed over in the development of the later forms of this family. Such a case of arrested development, and fixation of larval as specific characters, seems to be presented to us in the species *Bathyuriscus pupa* of the Mt. Stephen fauna,† as well as in *Acantholenus spiniger*.

That the form which we have described as an early moult of *Asaphellus Homfrayi* is Asaphoid, though so far removed from the adult in form, I think is shown by its peculiar glabella, fading away at the front into the frontal area of the cheeks, so that the line of demarkation between the two is not clearly traceable, a very common character in the Asaphoid trilobites. In this form it appears to the writer that the faint cresentic lobe in the front of the glabella is homologous with the front lobe of the glabella and the eyelobes collectively, and that the flaring anterior ends of the dorsal furrows represent the posterior half of the eyelobes. The obscurity of the occipital furrow is also an Asaphoid character.

If Conophrys is a valid genus Mr. E. Billings' genus Shumardia has precedence of it by five years. *S. granulosa* (Billings) of the Quebec group is evidently a diminutive trilobite of the same type and from near the same horizon.‡ *S. glacialis*, of the same author, probably belongs to another genus.†

The late Dr. Henry Hicks, described from the Tremadoc group in South Wales, two species of "Niobe," which Prof. W. C. Brœgger refers to Asaphellus§; one of these, *N. Menapiensis*, is too large to compare with the Cape Breton species; the other, *N. Solvensis*, differs in the form of the movable cheek, and of the hypostome.

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* Bull. Nat. Hist. Soc. N. B. St. John, 1898, No. xvi, p. 40.

† Trans. Roy. Soc. Can. 2nd Ser., vol. v, sec. iv, p. 51, pl. ii, fig. 5.

‡ Palæozoic Roy. Soc. Can. 2nd Ser., vol. v., sec. iv, p 51, pl. ii, fig. 5.

§ Euloma Niobe Fauna, Christiania, '96, 47. p.

ASAPHELLUS (?) PLANUS, n. sp. Pl. XVIII, fig. 11.

A broad oval species with smooth shield and prominent eyelobes.

The head shield is semicirclar, with strong cheek spines. It is about twice as wide as long, and has a broad flat margin.

The middle piece of the head shield is narrowed in the middle by the eyelobes being placed close to the side of the glabella.

The facial sutures are strongly arched out in front of the eyelobe and turning meet along the front margin; the front area of the cheek thus left, is wider than the middle piece at the eyelobe, and three-fifths of the width at the back of the middle piece. The suture curves out boldly behind the eyes, turning inward again near the posterior margin, which it cuts about a third of the distance from the outer margin of the head shield.

The glabella is level with the cheeks, except at the front, where it slopes down to the flattened anterior margin. The eyelobes are strongly elevated, short, and placed about half way from the front of the shield. There is a minute tubercle on the axial line one-quarter from the back of the head. The posterior marginal furrow is short and shallow, and the occipital ring narrow and obscure.

The movable cheek behind the eyelobe is nearly as wide as the glabella; the front runs beneath the front margin of the middle piece in a wide semi-doubleur what extends to the axial line. Posteriorly, it is lengthened into a genal spine, which, from the facial suture to the point, is as long as the posterior extension of the suture.

The movable cheek, under the eyelobe, carries a convex band of several rows of minute ocular facets arranged diagonally; those in front of the middle of the band run diagonally upward and forward, those behind the middle run diagonally upward and backward.

The thorax of eight joints has long, narrow segments, terminating in rounded points, strongly facetted; the ring of the middle segment is about as long as the pleuræ; the pleuræ are bent (but scarcely geniculate) at one-half of the length of the first segment; they bear a quite shallow furrow directed backward; each ring of the thorax has a narrow articulating band.

A thorax and pygidium of smaller size, supposed to belong to this species, has the following characters: The pygidium is broadly semicircular and no axis is visible; a slight broad protuberance one-third

from the posterior end indicates the termination of the rachis; the sides lobes are sloped down to a somewhat flattened margin. On each side lobe there is a shallow groove near the front.

The hypostome in this species is unknown, therefore the reference to Asaphellus is provisional.

Sculpture.—The surface of the shell of this trilobite is smooth or minutely punctate. The underside of the movable cheek has a rugulose surface on the upper part, and a finely concentrically striated band on the slope outside of this; the flattened band is covered with widely spaced anastomosing raised lines, parallel to the margin of the shield.

The composition of the test in this species is different from that of *A. Homfrayi* which has a shining and polished surface as preserved in the shale; this, on the contrary, had a dull surface, and appears to be more calcareous, as there is little but a film of the shell substance left, where the containing shale has been exposed to weathering.

Size.—Length, about 70 mm.; width, about 55 mm.; length of head shield about 26 mm.; of the thorax, 20 mm.; of the pygidium, about 24 mm. The pleuræ are about 45 mm, long, and the pygidium of about the same width. Scarce.

A. (?) *planus* is distinguished from *A. Homfrayi*, var. by its broader glabella, more prominent and more distant eyes, broader and less pointed front to the middle piece of the head shield, more obscure neck furrow, narrower thoracic rings, and the smooth and obscure axis of the pygidium.

This form might be referred to Niobe, but for the obscurity of the glabella (and the almost entire absence of rachis to the pygidium, if we are right in referring the smooth pygidium to this head and thorax). This form cannot belong to *Platypeltis*, Cal., because it has eight segments, and no frontal enlargement of the glabella is traceable; on the contrary, the glabella is conically rounded, as in Asaphus.

This article is published with the permission of the Director of the Geological Survey. Dr. R. Bell.

Issued. St. John, N. B., January, 1902.

EXPLANATION OF THE PLATES.

PLATE XIII.

FIG. 1. *Acrothyra signata* mut. *prima* n. mut. $2\frac{1}{2}$ x $2\frac{1}{4}$ x $1\frac{1}{4}$ m. Mag. $\frac{8}{1}$; —*a* Ventral valve; —*b* Mould of interior of same; —*c* Ventral from the side; —*d* Another ventral with low umbo; —*e* Dorsal valve; —*f* Mould of the interior; —*g* Dorsal from the side. From Coldbrook Group at Dugald Brook, Escasonie, N. S. See p. 382.

FIG. 2. *Acrothyra signata* n. sp. 3 x 2 x 1 mm. Mag. $\frac{10}{1}$; —*a* Ventral valve; —*b* Mould of the interior; —*c* Ventral valve from the side; —*d* Dorsal valve; —*e* Mould of interior of same. From Assise E.1*b* (Lower Etcheminian), Dugald Brook, Escasonie. See p. 381.

FIG. 3. *A. signata* mut. *sera*, n. mut., $2\frac{1}{2}$ x $2\frac{1}{2}$ x $1\frac{1}{2}$. Mag. $\frac{10}{1}$; —*a* Ventral valve; —*b* Mould of interior of same; —*c* Ventral from the side; —*d* Dorsal valve; —*e* Mould of interior; —*f* Dorsal from the side. From Assise E.1*c* (Lower Etchemin.) at Dugald Brook, Escasonie, N. S. See p. 383.

FIG. 4. *A. signata*, mut. *orta*, n. mut., 2 x $1\frac{3}{4}$ x 1 mm. Mag. $\frac{10}{1}$; —*a* Ventral valve, mould of interior showing visceral callus; —*b* Another narrower, showing traces of extension of the callus; —*c* Ventral from the side; —*d* Dorsal valve; —*e* Mould of interior of the dorsal; —*f* Dorsal from the side. From Assise E.2*c* (Lower Etchemin.) at Dugald Brook, Escasonie, N. S. See p. 385.

PLATE XIV.

FIG. 1. *Acrothyra signata* mut. *tarda*, n. mut., $2\frac{1}{2}$ x 3 x $1\frac{1}{2}$ mm. Mag. $\frac{10}{1}$; —*a* Ventral valve from above; —*b* Mould of interior of a ventral; —*c* Same seen from behind; —*d* Ventral valve from the side. From Assise E.1*d* (Lower Etchemin.) at Dugald Brook, Escasonie, N. S. See p. 384.

FIG. 2. *Acrothyra proavia*, 2 x $1\frac{1}{2}$ x $\frac{3}{4}$ mm. Mag. $\frac{10}{1}$; —*a* Ventral valve; —*b* Same from behind; —*c* Same from the side; —*d* Dorsal valve; —*e* Mould of the inside of this valve; —*f* Dorsal from the side; —*g* Outline of the two valves, from the side. From Assise E.3*c* (Upper Etchemin.) at Dugald Brook, Escasonie, N. S. See p. 386.

FIG. 3. *A. proavia*, large valves, 3 x $2\frac{3}{4}$ x $\frac{3}{4}$ mm. Mag. $\frac{10}{1}$; —*a* Ventral valve; —*b* Another ventral with corrugated front; —*c* Ventral from the side; —*d* Dorsal; —*e* Mould of interior of the dorsal; —*f* Dorsal valve in profile. From Assise E 3*e*, lower part, (Upper Etchemin.) at Dugald Brook, Escasonie, N. S. See p. 387.

FIG. 4. *A. proavia*, mut. *prima*, n. mut., 3 x 2 x $1\frac{1}{2}$ mm. Mag. $\frac{10}{1}$; —*a* Ventral valve; —*b* Mould of interior; —*c* Ventral, from the side; —*d* Dorsal valve; —*e* Mould of interior; —*f* Dorsal from the side. From Assise E.3*a* (Upper Etchemin.) at Dugald Brook, Escasonie, N. S. See p. 389.

FIG. 5. *A. proavia*, mut. *crassa*, n. mut., $2\frac{1}{2}$ x 2 x $1\frac{1}{2}$ mm. Mag. $\frac{10}{1}$; —*a* Ventral valve; —*b* Mould of same; —*c* Ventral from the side. From Assise E.3*e*, lower part, (Upper Etchemin.) Dugald Brook, Escasonie, N. S. See p. 389.

PLATE XV.

FIG. 1. *Acrotreta papillata*, n. sp., $2\frac{1}{2}$ x $2\frac{1}{2}$ x $1\frac{1}{4}$ mm. Mag. $\frac{10}{1}$; —*a* A narrow ventral valve; —*b* Same from the side; —*c* Mould of interior of a ventral valve; —*d* Dorsal valve; —*e* Same from the side; —*f* Mould of interior. From Assise E.1*d* (Lower Etchemin.) at Boundary Brook, Escasonie, N. S. See p. 390.

FIG. 2. *A. papillata*, mut. *prima*, 2 x $2\frac{1}{2}$ x $1\frac{1}{4}$ mm. Mag. $\frac{8}{1}$; —*a* Ventral valve; —*b* Same, side view; —*c* Mould of ventral. From the Coldbrook Group, Dugald Brook, Escasonie, N. S. See p. 391.

FIG. 3. *A. papillata* var. *lata*, n. var., 2 x $2\frac{1}{2}$ x $1\frac{1}{4}$ mm. Mag. $\frac{10}{1}$; —*a* Ventral mould of interior; —*b* Same from the side; —*c* Same from behind. From Assise E.1*d* (Lower Etchemin.) at Boundary Brook, Escasonie, N. S. See p. 391.

FIG. 4. *Acrotreta gemmula*, $1\frac{1}{2}$ x $1\frac{1}{2}$ x 1 mm. Mag. $\frac{10}{1}$; —*a* Ventral from behind ; —*b* Same from the side ; —*c* Ventral, mould of interior ; —*d* Dorsal, interior. From Protolenus Beds, Hanford Brook, N. B. See p. 395.

FIG. 5. *Acrotreta cf. socialis*, v. Seebach 3 x 3 x 2 mm. Mag. $\frac{6}{1}$ (except *e.* and *k.*) ; —*a* Ventral valve ; —*b* Same from the side ; —*c* Mould of interior ; —*d* Same from the side ; —*e* Apex of the mould, mag. $\frac{8}{1}$; —*f* Dorsal valve ; —*g* Same from the side ; —*h* Mould of interior ; —*i* Same from the side ; —*k* Enlargement of surface sculpturing, mag. $\frac{15}{1}$. From Lingulella radula Zone, (St. John Gr : C.2*c*), McNeill Brook, Mira, N. S. See p. 392.

PLATE XVI.

FIG. 1. *Acrotreta Baileyi*, $3\frac{1}{2}$ x 4 x 1 mm. Mag. $\frac{4}{1}$; —*a* Ventral, mould of interior ; —*b* Same from the side ; —*c* Dorsal, mould of interior ; —*d* Same from the side. (C.1*d*) Lower Paradoxides Beds, King's Co., N. B. See p. 395.

FIG. 2. *Acrotreta bisecta* 3 x $3\frac{1}{4}$ x $3\frac{1}{2}$ mm. Mag. $\frac{6}{1}$; —*a* Ventral valve ; —*b* Mould of interior from the side ; —*c* Same seen from above ; —*d* Dorsal valve ; —*e* Mould of interior from behind ; —*f* Same from the side ; —*g* Same from above. From the Dictyonema Beds, (C.3*c*) McLeod Brook, Boisdale, N. S. See p. 394.

FIG. 3. *Acrothele abavia* n. sp., $6\frac{1}{2}$ x $6\frac{1}{2}$ x $\frac{3}{4}$ mm. Mag. $\frac{4}{1}$; —*a* Ventral valve, interior, the umbo is filled with a plug of fine sand ; —*b* Same from the side ; —*c* Dorsal valve, interior, the shell is broken away at the umbo ; —*d* Same from the side. From Assise E.3*a* (Upper Etchemin.) at Dugald Brook, Escasonie, N. S. See p. 398, 402.

FIG. 4. *Acrothele abavia* n. sp., $5\frac{1}{2}$ x 6 x 1mm. Mag. $\frac{4}{1}$; —*a* Ventral valve, interior ; —*b* Dorsal valve, interior. From Assise E.3*b* (Upper Etchemin.) at Dugald Brook, Escasonie, N. S. See p. 398.

FIG. 5. *Acrothele avia*, mut. *puteis*, n. mut. 6 x 6½ x 1 mm. Mag. $\frac{4}{1}$; —*a* Ventral valve, mould of interior; —*b* Dorsal valve, interior. From Assise E.3*d* (Upper Etchemin.), Dugald Brook, Escasonie, N. S. See p. 398, 402.

FIG. 6. *Acrothele Matthewi* var. *costata*, 5 x 6 mm. Mag. $\frac{4}{1}$. From the Protolenus Beds, Hanford Brook, St. John Co., N. B. See p. 397.

FIG. 7. *Acrothele avia* — Enlarged sculpture. See Plate XVII.

PLATE XVII.

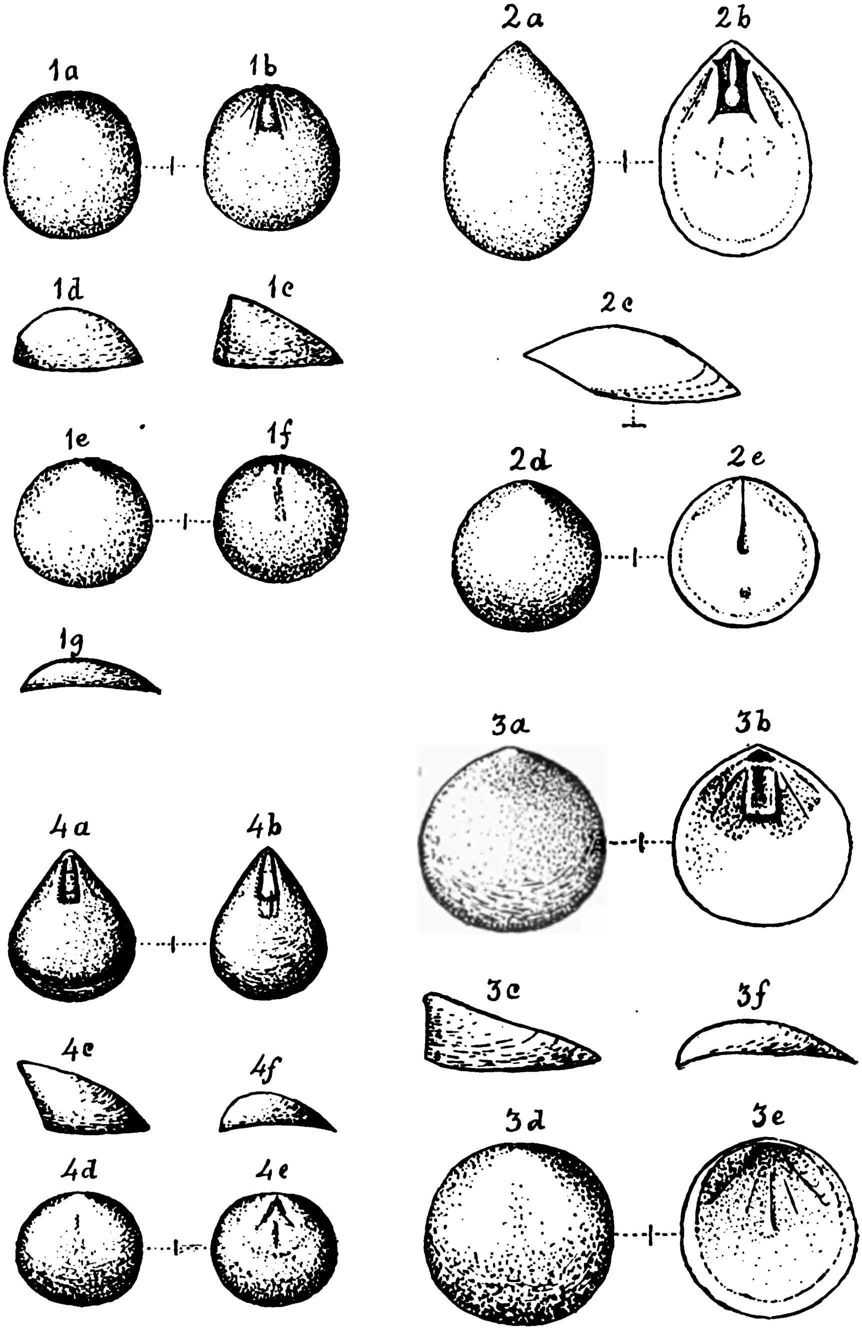
FIG. 1. *Acrothele avia* 9 x 10 x 1 mm. Mag. $\frac{6}{1}$ (except *c.* to *f.*); —*a* Ventral valve, central part; —*b* Same seen from the side: —*c* Ventral, interior of; —*d* Dorsal valve; —*e* Same in outline; —*f* Dorsal, interior—*c.* to *f.* mag. $\frac{3}{1}$. Fig. 7 of Plate XVI; —*a* Surface sculpture on lateral slope of ventral; —*b* Sculpture on middle part of ventral. Both mag. $\frac{10}{1}$. All from Assise E.3*e* (Upper Etchemin.) at Dugald Brook, Escasonie, N. S. See p. 396, 402.

FIG. 2. *Acrothele avia*, broad form, ventral, 7 x 9½ x 1 mm. Mag. $\frac{4}{1}$, Dorsal 5½ x 7 mm., mag. $\frac{5}{1}$; —*a* Ventral valve; —*b* Dorsal valve, mould of interior. From Assise E.3*d* (Upper Etchemin.) at Dougald Brook, Escasonie, N. S. See p. 397.

FIG. 3. *Acrothele proles* 8½ x 9 x 1 mm. Mag. $\frac{4}{1}$; —*a* Ventral valve; —*b* Interior of same; —*c* A smaller dorsal valve; —*d* Interior of same; —*e* Outline of the valves from the side. From Assise E.3*f* (Upper Etchemin.) at Gillis', Indian Brook, Escasonie, N. S. See p. 400, 402.

FIG. 4. *Acrothele Matthewi* mut. *prima*. Mag. $\frac{2}{1}$; —*a* Ventral valve, showing the umbo close to the posterior margin; —*b* Same in profile. From Protolenus Beds (C.1*b*), Hanford Brook, N. B. See p. 397, 402.

FIG. 5. *Acrothele Matthewi*. Mag. $\frac{2}{1}$; —*a* Dorsal valve, interior, showing median septem and its branches, and fine striæ on the valve radiating to the anterior and lateral margins; —*b* This valve in profile. From Lower Paradoxides Beds (C. 1*c*), Hanford Brook, N. B. See p. 397, 402.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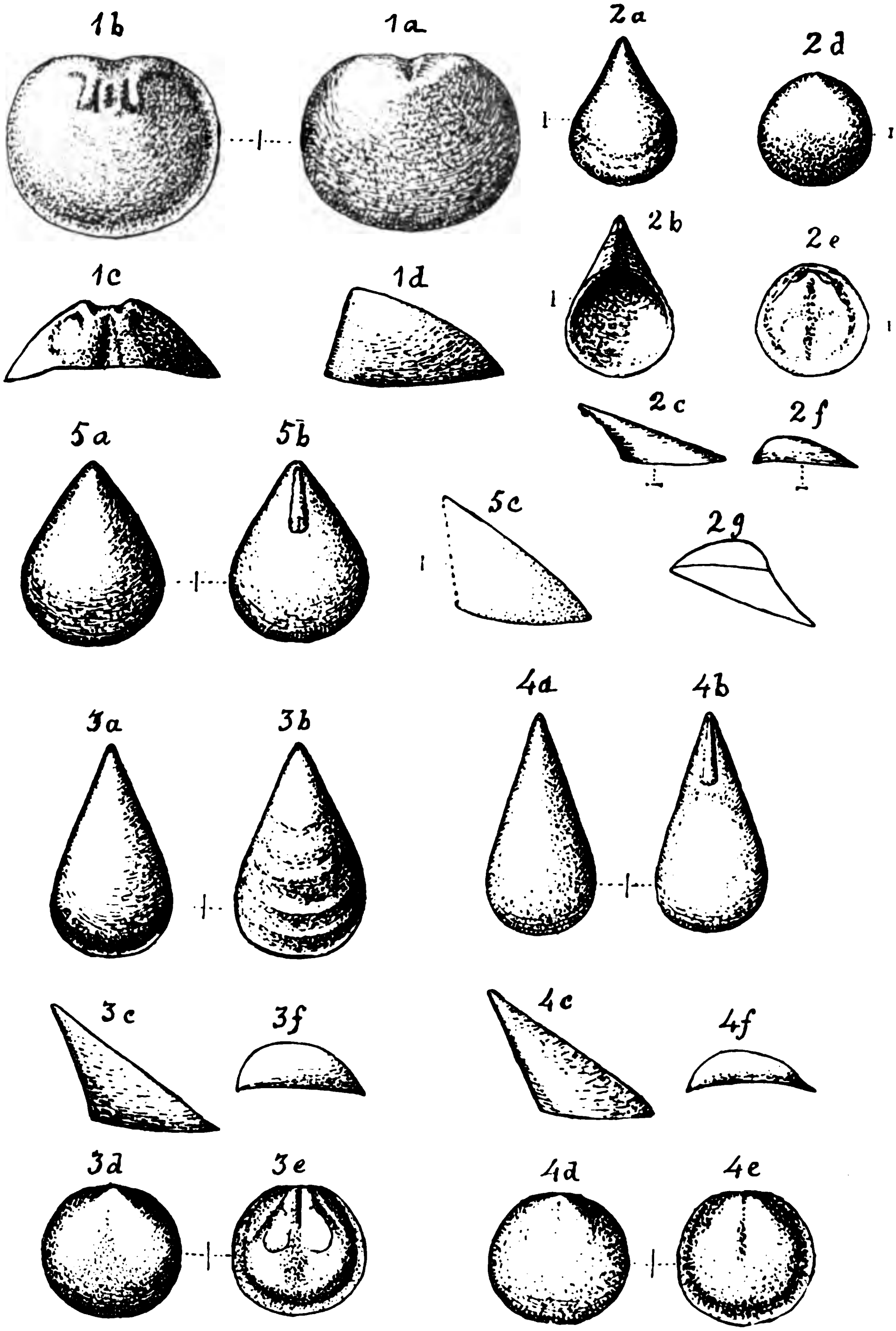
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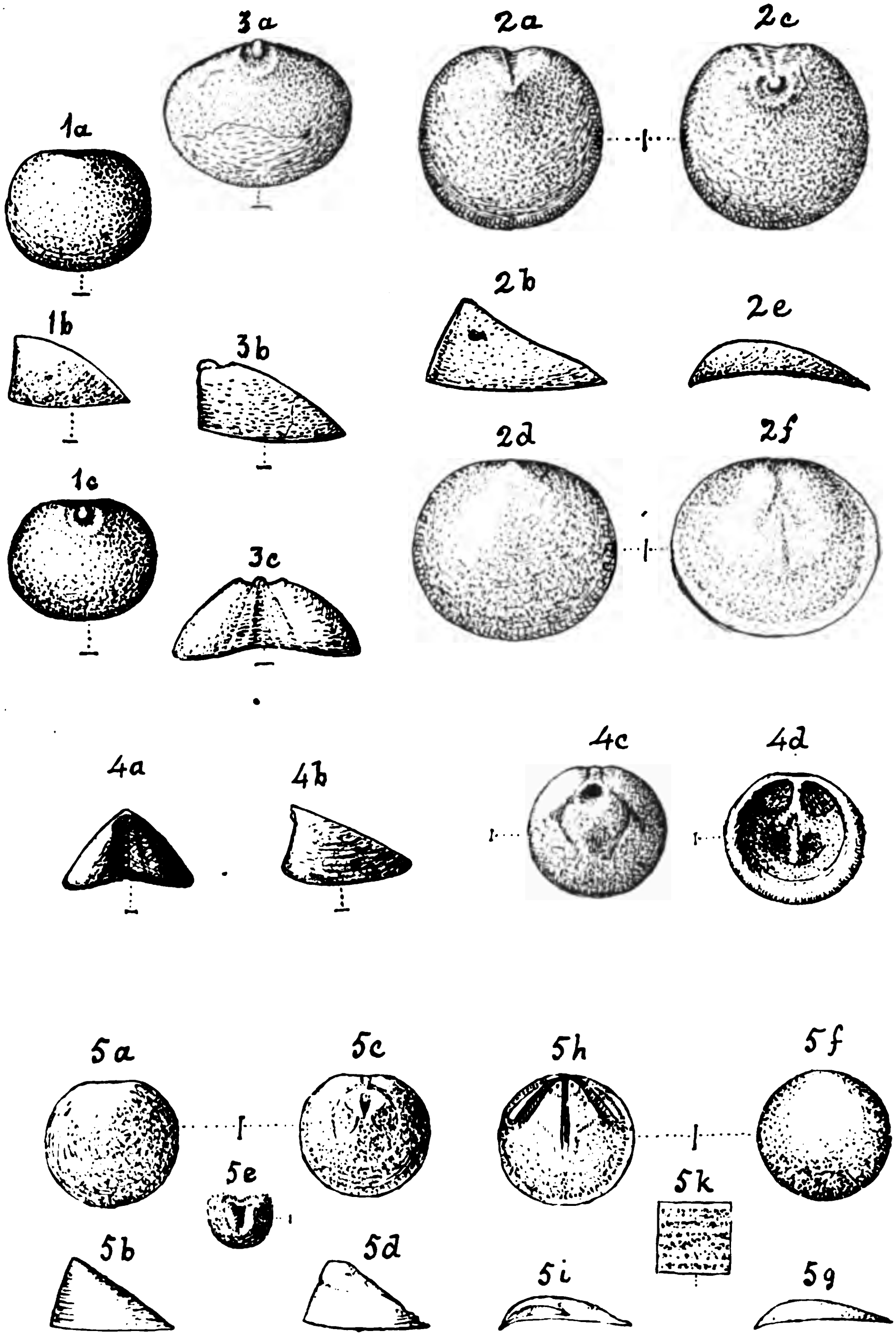
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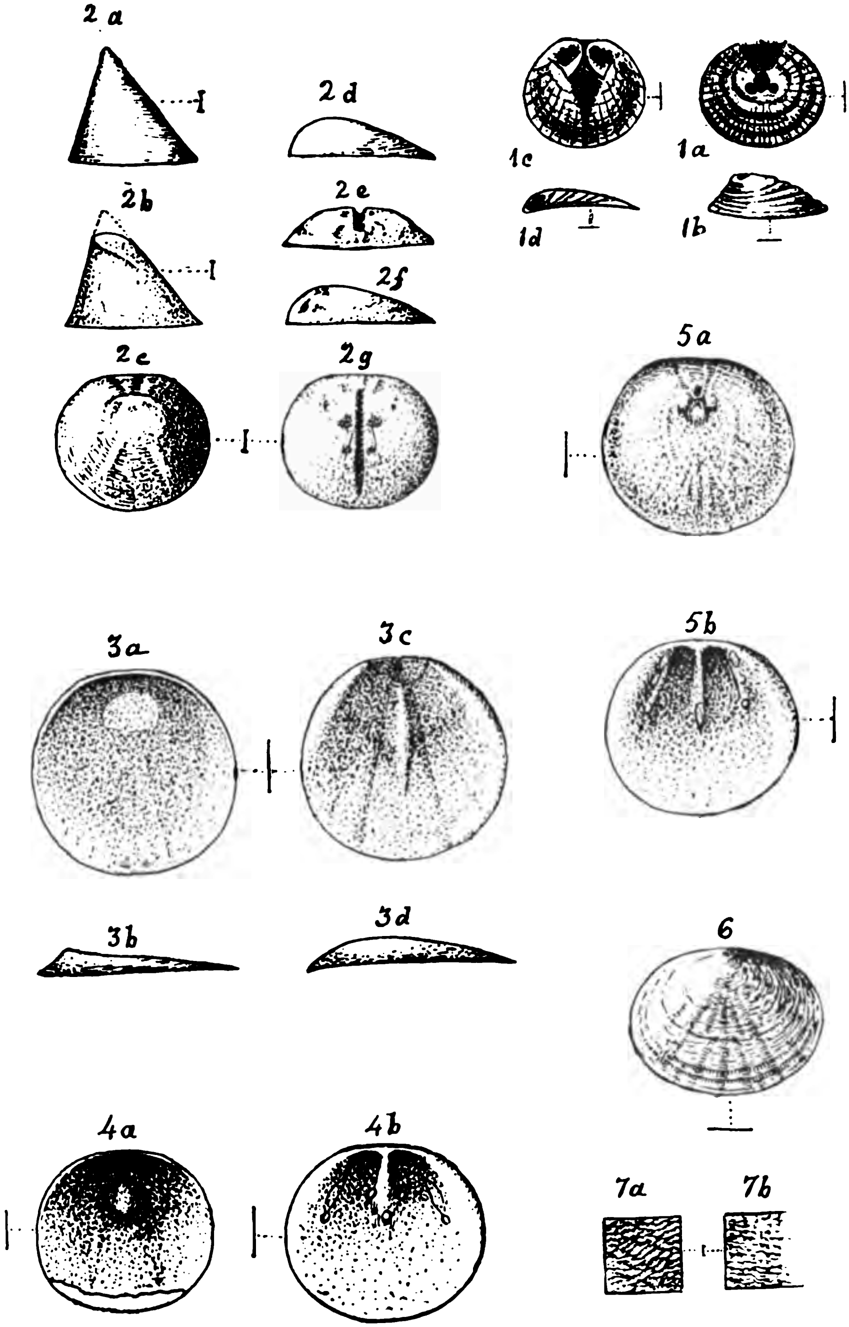
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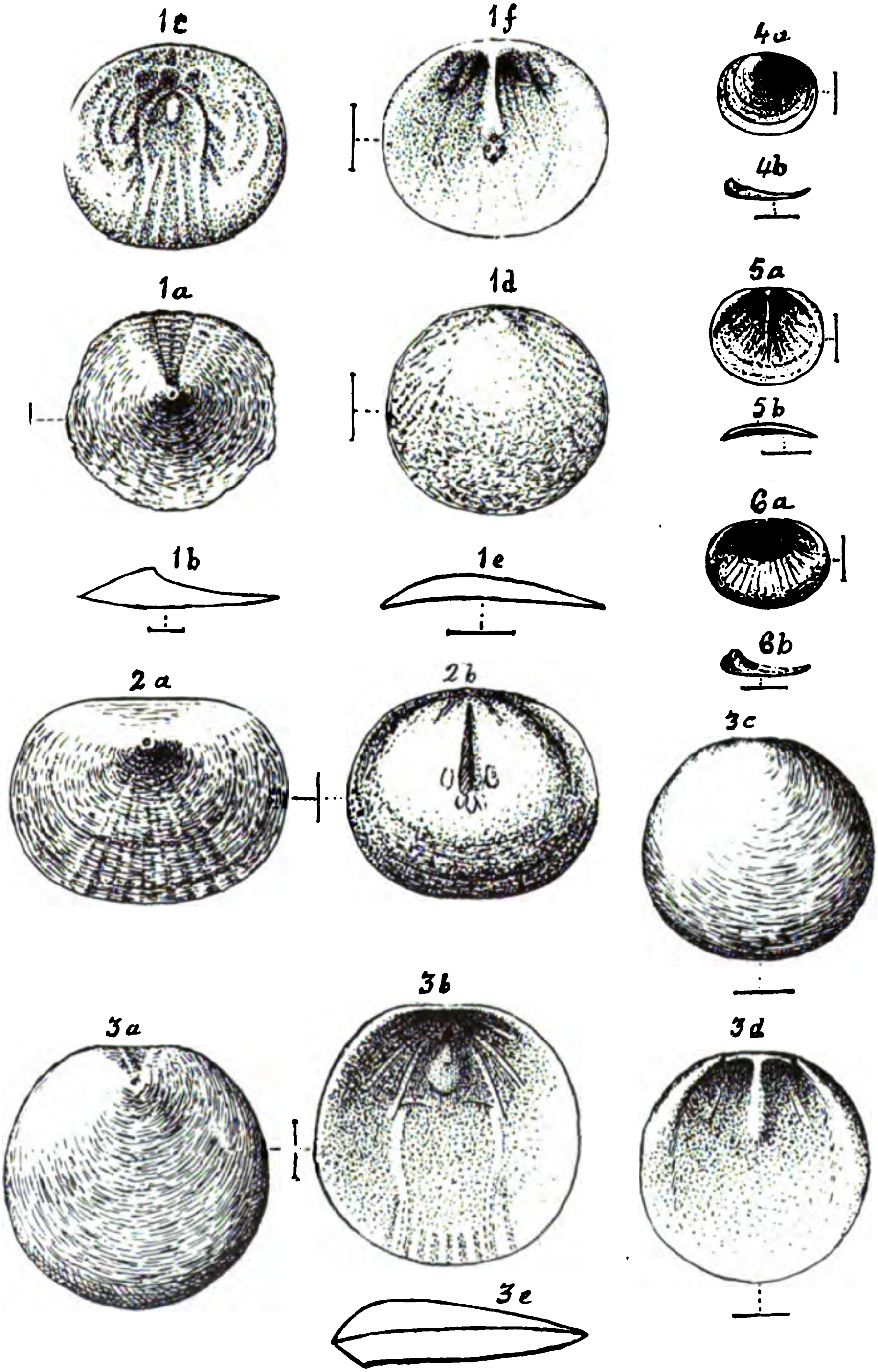
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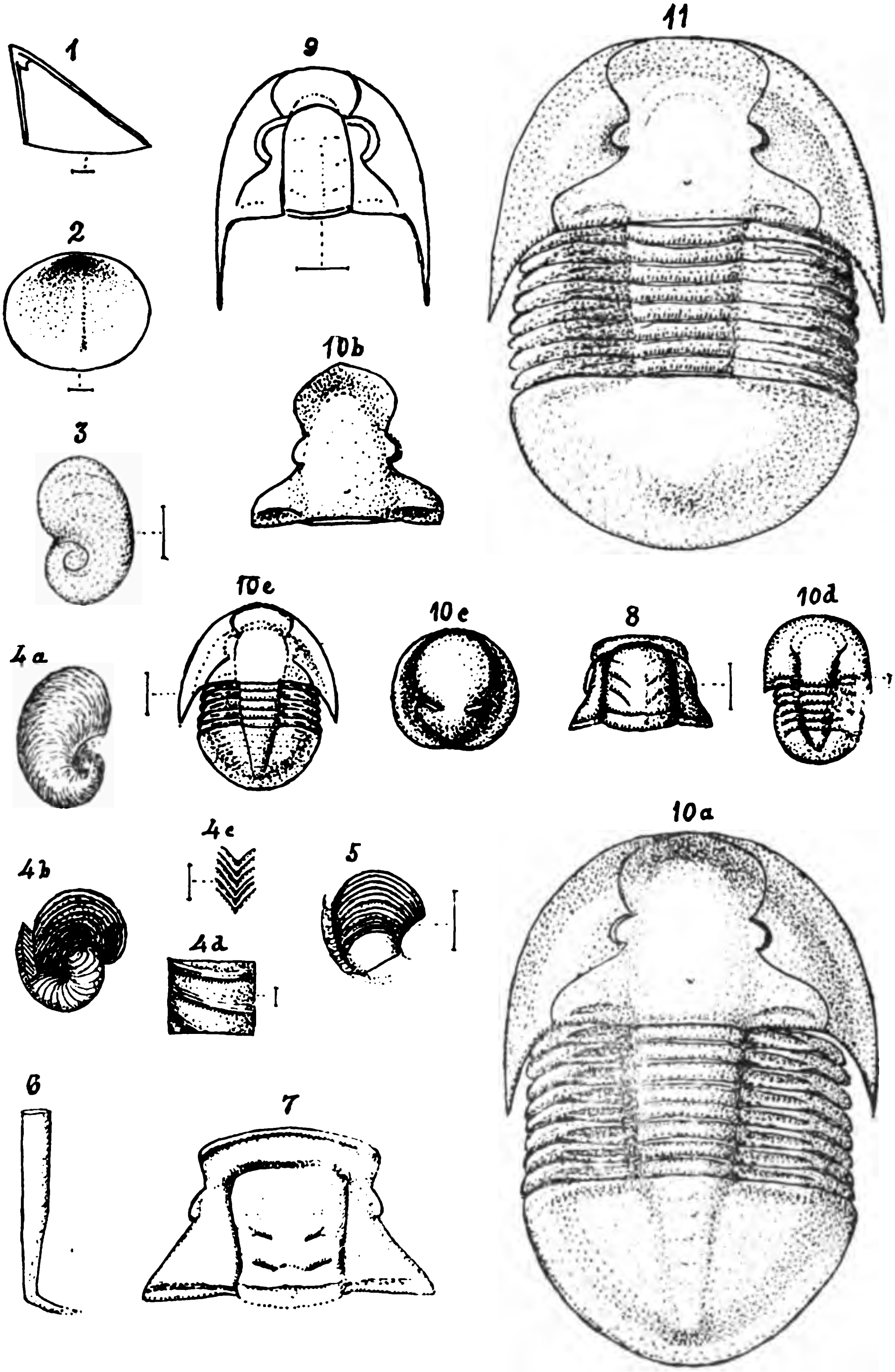
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FIG. 6. *Acrothele Matthewi* mut. *lata*. Mag. $\frac{2}{1}$; —*a* Ventral valve, interior; has two pits in front of the foramen, diverging-arched ridges on each side of the foramen, and a low ridge on each side of the foramen extending to the hinge line; —*b* A dorsal in profile, showing the position of the hinge-line. From Protolenus Beds (C.1*b*), Hanford Brook, N. B. See p. 402.

PLATE XVIII.

FIG. 1. *Acrotreta sipo* n. sp.—Section of ventral valve. Mag. $\frac{6}{1}$. See p. 406.

FIG. 2. *Acrotreta sipo*.—Interior of dorsal valve. Mag. $\frac{6}{1}$. See p. 406.

FIG. 3. *Bellerophon insulæ* n. sp.—Sinistral side. Mag. $\frac{3}{1}$. See p. 408.

FIG. 4. *Bellerophon Bretonensis* n. sp.; —*a* Dextral side; —*b* Broken valve, showing interior, etc., both natural size; —*c* Dorsum, showing the angle of the growth lines. Mag. $\frac{2}{1}$; —*d* Part of surface of body whorl. Mag. $\frac{4}{1}$. See p. 409

FIG. 5. *Bellerophon semisculptus* n. p.—Showing the outer whorl. Mag. $\frac{2}{1}$. See p. 410.

FIG. 6. *Urotheca* sp.—Tube showing the larval part and the living chamber. See p. 411.

FIG. 7. *Parabolinella quadrata* n. sp.—Middle piece of the head-shield; Natural size. See p. 411.

FIG. 8. *Triarthus Belli* n. sp.—Middle piece of the headshield, left side and occipital ring restored. Mag. $\frac{2}{1}$. See p. 412.

FIG. 9. *Angelina* ? sp. ?—Larval cephalic shield. Mag. $\frac{4}{1}$. See p. 413.

FIG. 10. *Asaphellus Homfrayi*, Salter, var.; — *a* Adult, broad form partly restored; *b* Middle piece of the head shield of the narrow form ;—*c* The hyposteme. All natural size; —*d* Early larval form, mag. $\frac{10}{1}$; —*e* A later larval form, mag. $\frac{4}{1}$. See p. 413.

FIG. 11. *Asaphellus* (?) *planus*. Adult. Natural size—the pygidium enlarged from another example supposed to be of this species. See p. 419.

ERRATA.

Page 319, line 21, after "Mr." insert, S. Ward.

" 380, " 10, before "New," insert (A)

" 381, in the table two heavy bars should be replaced by light ones.

" 387, line 8, for "in Assise *f*," read, on the highway at V. McPhee's, in Assise *e* ?

" " " 15, for "genus," read, Acrotretinæ

" " " 18, for "the" read, one; and for "*f*" read *e*

" 391, " 23, after "VAR" insert LATA

" " " 34, for PAPELLATA, read PAPILLATA

" 393, " 33, after "size," insert, and as to its interior by its

" " " 35, for "It," read, its interior; and for "A.," read, that of A.

" 395, " 22, In the columns to the right of "A. sipo" insert 3, 3, 2½, 1.2.

" 397, last line, erase "larger"

" 398, lines 10 and 27, for "XV," read, XVI.

" 400, line 10, for "XVI," read, XVII.

" 401, 3rd line from the bottom, for "*Conocoryphe*" read *Ctenocephalus*.

ARTICLE II.

NOTES ON THE NATURAL HISTORY AND PHYSIOGRAPHY OF NEW BRUNSWICK.

By W. F. Ganong.

44.—On Forestry Literature Important for New Brunswick.

(Read January 8, 1901.)

A well-formulated forestry policy is the most pressing need of New Brunswick. Its development must be based upon a knowledge of the experience of other countries, particularly of those which, like some of the eastern United States, are conditioned as to the forestry problem not unlike this province. For this purpose the reports of the United States government, and of the different states which have established Forestry Boards or Commissions, are invaluable. It would be of the greatest service to the forestry interests of this province if these reports could be collected together in some accessible place in New Brunswick while they are still obtainable. This could most appropriately be undertaken by this Society working through a "Forestry Committee," whose duty it would be to apply in the name of the Society, and of the Province, for these reports, and to keep them, when obtained, classified and accessible to all inquirers. The committee should also collect newspaper and other articles relating to Canadian forests, and take the leading American journals devoted to the subject. The principal reports of value would be the following. The United States Government, both through the Division of Forestry of the Department of Agriculture and through recent reports of the Geological Survey, has published the most abundant and valuable matter upon American forestry. The following states, through their Forestry Boards or Commissions, have issued valuable reports,— New York, New Jersey, Pennsylvania, Wisconsin, Minnesota, North Carolina. Maine has a Forestry Board which has published two or three reports, but its work appears to be suspended. There are also some scattered

publications of lesser importance by other states. A most valuable summary of the forestry legislation of these states is given in a recent article, "Progress in Forestry Under State Control," by Spalding, in *Science*, for December 28, 1900.

The attention of young men in New Brunswick should be called to the fact that two universities, Cornell and Yale, have established schools of forestry. There can be no question that forestry is opening up to young men a most attractive and remunerative profession, and one which will be in demand in New Brunswick within another decade.

45.—On the Physiographic History of the Tobique River.

(Read February 5, 1901; re-written January, 1902.)

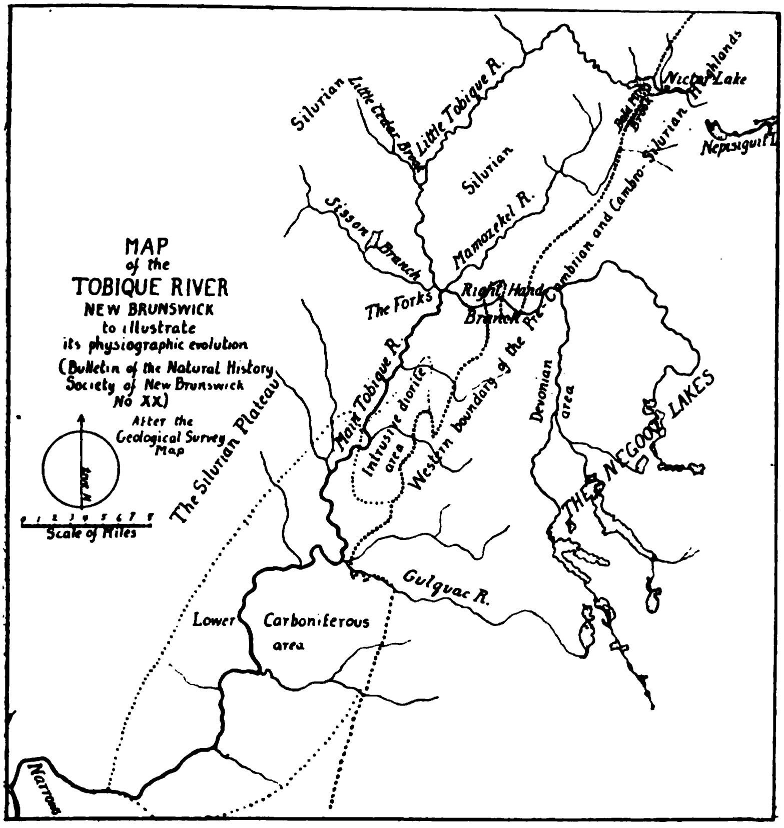
In earlier notes I have tried to trace the physiographic evolution of two of the finest of our northern rivers, the Restigouche and the Nepisiguit; I shall now attempt to treat in the same way the third of a noble trio, the Tobique. All three of these rivers are notable for their great natural beauty, but each has its own personality and differs from the others. The Restigouche is the lovelier, but the least varied. The Nepisiguit is the sterner, and the least friendly. The Tobique is the riper, most varied and most companionable.

The reader can the better follow the present discussion if he has before him the excellent sheet of the Geological Survey including this river, from which the accompanying reduced sketch is taken (Map No. 1). Although both topography and geological boundaries are necessarily inaccurate in some details, we may, as a whole, assume their essential correctness.

From our present point of view the Tobique falls into four portions as follows: (1) The river below the Forks, which I shall call the Main Tobique, (2) the Right Hand Branch, (3) the Little Tobique, and (4) the Mamozekel. Of these, all are a complete wilderness except the Main Tobique. I am personally acquainted with them all except the Mamozekel, and the following observations and conclusions have, for the most part, been worked out upon the ground.

We must, first of all, note the general structure of the region. Excepting the Right Hand Branch, the Tobique flows southwest, approximately parallel with the line of contact of two distinct series of geological formations. On the southeast lie the Central Highlands, of

crystalline Pre-Cambrian, fringed by a border of Cambro-Silurian or Cambrian, rocks, having a minimum water-elevation on the principal lakes of over 1,200 feet, and rising thence into broken plateaus and hills from 1,700 to 2,700 feet in height. As will later be shown (Note No. 49), these highlands are the remnants of an ancient much-



MAP NO 1.

dissected, warped, and perhaps faulted, peneplain,—the same, I believe, as that described by Daly in Nova Scotia, which he homologizes with the Cretaceous Peneplain of New England. Sharply marked off from this is the great rolling plateau on the northwest, in which the Tobique runs, with minimum lake levels of over 700 feet and a general elevation of 800 to 1,000 feet. It is composed, for the most part,

of highly disturbed Upper Silurian rocks, but includes a large area of little disturbed Lower Carboniferous on the Lower Tobique. Evidently this plateau represents the remnant of a second and younger peneplain, far less dissected than the older, which, although much higher above the sea level, is without doubt the equivalent of the newer peneplain recognized by Daly in Nova Scotia, and homologized by him with the Tertiary Peneplain of New England. Whatever we may think as to the mode of origin of these peneplains, or as to their age, there can be no question as to their real existence. This conception of the two peneplains throws a flood of light upon the topography of Central New Brunswick, which, without them, is most confused and well nigh impossible of interpretation.

We turn now to the Right Hand Branch. As already described (Note No. 39), this includes a number of valleys deeply cut into the Pre-Cambrian highlands, and converging northward. All that we can be sure of as to their age is that they are at least as old as the peneplain into which they have cut, which, tentatively, we may agree with Daly in assigning to Cretaceous age, but they may be very much older An important point about them, however, is this: that their direction of flow is nearly in reverse of that of the Main Tobique river. This can only be explained by the supposition that the peneplain, when they began to cut into it, had a slope to the northward and sent these rivers draining into waters whose modern representative is the Bay Chaleur. The entire Silurian plateau would at that time have been filled with rocks to the level of this Cretaceous plateau, and the remainder of the Tobique could not then have been in existence.

In this connection we may well consider another part of the Tobique which has probably had a similar history, namely, the upper part of the Little Tobique, together with the Nepisiguit Lakes. As has been pointed out by Chalmers (Note 33), in Pre-Glacial times the Nepisiguit Lake valley doubtless emptied into the Nictor Valley; and the direction of flow of this Nictor Nepisiguit valley, parallel with the Right Hand Branch, and its similar general relation to the formations of the region, makes it seem certain that it is of the same age and has had the same history as the Right Hand Branch.

We next turn to the Main Tobique and the Mamozekel, the latter a direct continuation of the former. It seems plain that these two are morphologically one river, and together form the real Main Tobique. With the Mamozekel I am not familiar, though I have seen

its valley at its mouth, and from the mountains near Nictor Lake. The Main Tobique has cut from three or four to six or seven hundred feet into the Silurian plateau in a winding rock-walled but well-matured valley, provided frequently with extensive intervales. Its age must therefore be at least that of the peneplain into which it has cut, which tentatively we may assume with Daly as of Tertiary age, and it may be very much older. The question now arises as to why it flows southwest into the St. John, instead of northeast into Bay Chaleur, as the Right Hand Branch doubtless once did? There can be no doubt, I believe, that the same causes sent it southwest (in fact, originated it) which turned the St. John from its proper course into Bay Chaleur and sent it through the highlands southward, a peculiarity which has greatly complicated not only the physiographic, but also the human history of this region.*

There are three possible explanations of the age and cause of this change of course of the St. John and origination of the Main Tobique. First, it may be co-temporaneous with the beginning of the elevation of the newest peneplain. In this case we must hold that the peneplanation (Tertiary?) of the Silurian plateau was effected by rivers flowing into Bay Chaleur, and that all through this period the St. John, the Right Hand Branch and the Nictor-Nepisiguit thus emptied, while the Main Tobique did not exist. With the beginning of the elevation of this peneplain, however, inaugurating the present cycle, and allowing the rivers to cut their present deep channels, that elevation would have commenced, and must been comparatively rapid on the northward, thus turning back the slow-moving St. John, Right Hand Branch and Nictor from their courses into Bay Chaleur, and throwing their waters southwest where they would accumulate, perhaps in a huge lake, until this reached the height of the lowest point in the highlands, when they would escape southward, thus originating the course of the present St. John and the Tobique. The Main Tobique would therefore have originated by the turning southwest of the drainage of the Right Hand Branch, while the Mamozekel, similarly originated by the same turning of the Nictor-Nepisiguit waters, which as will presently be shown, formerly emptied by the Mamozekel. Both Main Tobique and Mamozekel would follow the trough between this uplift on the north and the higher land on the southeast. On

* Particularly in connection with political boundaries, as I shall show in a later note.

this supposition the change of the St. John and origin of the Main Tobique would be Tertiary, or post-Tertiary. Second, it is possible this change was one cycle older, namely, that it took place by the same method of more rapid elevation northward (and scarcely any other explanation is under the circumstances imaginable) with the elevation of the earlier (Cretaceous) peneplain, and that the peneplanation of the later plateau was effected largely by rivers flowing into the St. John. There are certain facts which tend to substantiate this view, notably the very winding course of the rock-valley of the Main Tobique, which is best explained by the supposition that it existed as a ripe river wandering in a matured flood plain when the latest elevation began. This would make its age Cretaceous, or post-Cretaceous, on the hypothesis of that age for this older peneplain. Third, the presence of little-disturbed Lower Carboniferous rocks in the lower valley of the Main Tobique suggests an early connection with the sea by way of the present St. John valley, for fragments of that formation are found at intervals along the St. John down to the great central Carboniferous basin; while on the other hand, in the northeasterly direction, no traces of it are known until the present Bay Chaleur is reached. Both the St. John and the Tobique may therefore be the successors of rivers which have flowed in their respective directions from pre-Carboniferous times. In this case the change of direction of the St. John and the formation of the Tobique would have occurred in consequence of an elevation northward accompanying the profound disturbances which took place in this region in the Devonian period, disturbances which affected the Upper Silurian rocks of this region, but did not affect those of the Lower Carboniferous.

Further research will doubtless yield facts which will permit a decision as to these three possibilities. In the meantime it seems most probable that the Main Tobique existed prior to the latest elevation and assisted with the St. John in the peneplanation of this Silurian plateau.*

*In my earlier note on the Restigouche (No. 37), I imply too great an age to that river by speaking of it simply as post-Silurian. Its age must, I think, be the same as that of the Tobique, although in many ways it seems much newer. Thus, although in rocks at least as soft as the Main Tobique, its valley is much narrower and more V shaped, and almost entirely lacks intervales, which the Tobique nearly everywhere has. Were it not for its very winding valley in the lower part of its course, implying that it, like the Tobique, was a mature river wandering on a flood plain at the beginning of the last elevation, I would consider it as originating only after the elevation of the peneplain, and hence much newer than the Tobique. In any case I think there is no doubt its upper waters from the Kedgewick, if not from Tracy's Brook, have been captured from the St. John.

Turning attention more particulary to the Mamozekel, we note that it forks at its head into two branches, which approach respectively the Nictor and Nepisiguit Lakes. As shown in an earlier note (No. 29), there are but low valleys between the lakes and these branches, indicating a former connection and drainage into the Mamozekel. All of the facts seem in harmony with the explanation of this region already given, that the Nepisiguit-Nictor-Valley and the upper part of the Little Tobique, as far as the right-angled bend, form part of an ancient valley, whose waters, by the same causes which turned the Right Hand Branch southward to form the Main Tobique, were turned southward to form the Mamozekel. Which of the two connections with the Nictor-Nepisiguit-Valley is the older, remains to be determined. Subsequently the latter valley was captured from the Mamozekel by the Little Tobique, and finally the Nepisiguit part of the valley was turned by glacial drift down the Nepisiguit River.

We turn next to the Little Tobique which winds about in a wide gravel-bottomed valley. It enters the Main Tobique at exactly the same point as the Right Hand Branch, a fact which can hardly express a mere coincidence, and which, doubtless, indicates some casual connection. This is, probably, because the lower part of the Little Tobique occupies the ancient valley by which the Right Hand Branch flowed northward before the Main Tobique was formed. Possibly the Sisson Branch occupies the position of that ancient river, and the Little Tobique may originally have been but a branch of it. Probably the Little Tobique at first headed in the present Little Cedar Brook, and then sent off a branch which captured the Nictor Valley at the right, angled Bend.

The present Tobique River, therefore, has had its present approximate form and extent since, at least, the beginning of the elevation of the younger peneplain, and, perhaps, much longer. It is still steadily cutting its channel into the peneplains, giving origin to its charming scenery, and cutting back at its heads. One phase of this extension deserves special mention, namely, one of its branches, the Gulquac, has extended back at its head until it has actually tapped the system of lakes at the head of the Right Hand Branch. Theoretically, this process can go on until all of those lakes are turned by shorter courses into the Tobique, thus further complicating the physiography of this region. The Main Tobique has cut down in one place into ancient

intrusive rocks which, no doubt, underlaid the Silurian rocks when the valley of the river began to cut its present channel.

It remains but to speak of the effect of the glacial period upon the development of the river as we find it to-day. I can trace but four effects. First, the various lakes were formed, at least in part, by dams of glacial drift. Second, the Nepisiguit Lake valley was, doubtless, turned from the Nictor into the Nepisiguit by glacial drift. Third, all of the Little Tobique and the Main Tobique are smooth-flowing, gravel-bottomed rivers, because of the masses of drift available to the rivers for thus smoothing their beds. That they lack the boulder rapids, so abundant in most of our rivers, is due to the character of the drift brought into them from the north west — the soft Silurian slates easily worn down, instead of granite and felsite. Fourth, several falls and gorges have been formed on the river by the blocking of the old valley in places with drift. Of this nature are, probably, at least some of the falls on the Right Hand Branch, the Little Falls, the Ledges, Red Rapids, certainly Sisson Falls with their grand gorge, and the Narrows in which the fall is extinct.

The Tobique, then, despite its apparent complexity, appears to be a comparatively simple river with a steady and homogeneous development. It has captured no other rivers, and it has lost to other rivers nothing but the part of the Nictor Valley turned into the Nepisiguit in glacial times.

46.—Great Forest Fires in New Brunswick.

(Read March 5, 1901.)

By far the deadliest enemies of forests are fires, and their prevention is the greatest problem of the forester. In New Brunswick they have been abundant and disastrous from very early times, doubtless from the one near St. John two thousand years ago, which Dr. Matthew has described,* down to the present. A list of these great fires, with dates and extent, would have much interest and considerable economic use in helping to determine the rate of rapidity of natural reforestation in given districts. Such data about forest fires are being gathered by the Division of Forestry of the United States. I wish here to call attention to early accounts of two of our greatest fires. The worst

* Canadian Record of Science, viii, 213.

the province has ever suffered was, of course, the great Miramichi fire in 1825, of which we have a vivid description by Cooney in his History of Northern New Brunswick and Gaspé. A brief reference to the effects of a great fire before 1677 between the Nepisiguit and Miramichi is given by Father Christian LeClercq in his "Nouvelle Relation de la Gaspesie," in 1691, of which the part of interest to us is translated into English and published in Hay's Canadian History Readings (St. John, 1900), page 275. It is of interest to note that Father LeClercq attributes this fire, which must have nearly or quite equalled the later great fire of Miramichi, to lightning. In a still unpublished report on a survey of the river St. John, by Chas. Morris, in 1765, in the Public Record Office, a great fire of 1761 is referred to. Thus, he says of the Belleisle: "the Timber of all the Lands having been burnt about Four years ago by the Indians." Later he says: "All the Timber upon both sides Washademoak has been burnt by the Indians." Of Grand Lake, he says: "The Lands for a good way up the lake have suffered the same mischief as the lands of Washademoak, being burnt and all the timber destroyed." The implication in Morris' words is that the fires were set purposely by the Indians, which, if true, would recall the fires set periodically in the west by the Indians for purposes connected with hunting, and which are believed to be a chief cause of the treelessness of those regions.

47.—Measurements of Magnetic Dip in New Brunswick.

(Read March 5, 1901).

In the Society's Bulletin, No. XVII, page 105, Professor Duff gives a brief account of the scientific status of the study of magnetic dip, together with the results of some measurements made by himself in different parts of the province. He states that earlier observations are not known to him. Some earlier observations, over three hundred in number, were made, however, in 1840–41, by the surveyors of the north line from the source of the St. Croix, under charge of Major Graham. (United States, Executive Documents, 27th Congress, 2nd Session, 1841–42 Doc. 70). The results appear not to have been published in detail, but are doubtless preserved in manuscript in Graham's report in the Department of State at Washington.

48.—The Morphology of New Brunswick Waterfalls.

(Read March 5, 1901).

New Brunswick is a glaciated land of many rivers, and hence has many waterfalls. Waterfalls interest us in three ways: for their æsthetic charm, for the scientific problems involved in their origin, and for their economic value. I shall here discuss particularly the second of these phases of the subject.

Considered as to their origin, waterfalls group themselves into the following categories, which, like all of our classifications of natural objects and phenomena, are not distinct and exclusive, but merge into one another in the most varied combinations. Nor is it possible to draw any line between falls and rapids, for not only are there all gradations between, but there are some undoubted rapids which are much higher than some undoubted falls.

1. Glacial Falls.—This class includes the greater number, the best known and the largest of our waterfalls. Their mode of formation is familiar to all. In the Glacial Period masses of drift were often thrown into and across our river valleys. Where the valleys were deep and not completely filled, the drift was easily washed out again, leaving only the larger boulders to form the falls and rapids to be considered in the next class. Where the valleys were shallower, or the sides very irregular, the glacial dam often forced the water to leave its old channel and flow along or over a part of the rocky wall of the valley to fall again into the old valley below the obstruction. At the latter point a fall would be formed into a basin receiving both the old and the new courses of the river. But the fall, as falls always do, would begin to cut back into the rock over which the river flowed until a deep gorge is formed with the fall at its head. Above such falls, the river, still dammed back, often shows but a gentle current for a long distance. In this condition are most of the greater falls of the province, particularly those in the main courses of our principal rivers. Such are the Grand Falls of the St. John, with its pre-glacial valley on the right bank, the Grand Falls of the Nepisiguit, with its old valley on the left bank,* the Falls of the Magaguadavic at St. George, with the old valley on the left bank, where the town stands, Aroostook Falls and the great falls on the Sisson branch of Tobique.

* On this channel, see this Bulletin, No. XIX, 318.

Here belong also, no doubt, Gordon Falls on Pollet River, all the principal falls of the St. Croix (Salmon, Sprague's, Grand, Chepednec, Little and Tagwaan), those at the mouth of the Digdeguash, Upper Falls on the Magaguadavic, the four fine falls on the Lepreau* (Ragged, Big, Little, and that at the mouth), the Upsalquitch Falls at Ramsay's Portage, Pabineau and other falls on the Lower Nepisiguit, and numerous others on various streams throughout the province. Many of these, particularly those flowing in the hardest rocks, have insignificant gorges, but some of them possess gorges of great extent and impressiveness, of which the finest are those of the Grand Falls of the St. John, of the Nepisiguit and of the Sisson Branch.†

In some cases, where falls of this class once existed, there is now but a gorge, for the fall has worked completely back through the rocky ledges to the level of its old channel. The four greatest examples of such gorges in the Province are, that at the mouth of the St. John, the Narrows at the mouth of the Tobique, the Narrows on the Nepisiguit, four miles above Grand Falls, and the Narrows described by Ells on the Northwest Miramichi.‡ Probably most of the many places on our rivers which have the name Narrows, have had this origin.

Looking next at the distribution of the greater falls of this class, we at once observe that they are much more abundant on rivers, or portions of rivers, running in a general north and south (more exactly south-east) direction than on those running in a general west and east (more exactly north-east) direction. No doubt special local conditions of strike of formations, depth of valleys (in such a river as the Restigouche) and amount of drift available, etc., explain this peculiarity to a great extent, but they do not entirely; and the fact that the falls are most common in valleys following the direction of movement of the glaciers suggests that the glacial dams causing the falls are mostly of the nature of terminal moraines.

2. Boulder Falls.—When glacial drift was thrown into valleys in quantities not too great, the rivers afterwards removed it all except the boulders too large to be moved, which remained as obstructions in the channel, forming bad rapids and even small falls. Thus are caused

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* I am surprised that the great and picturesque falls on this river, particularly Ragged and Big Falls, seem so little known in the province.

† The Sisson gorge, unlike the others mentioned, which are U-shaped, and with mostly bare walls, is V-shaped, and with heavily-wooded walls.

‡ Geological Report for 1881, D. 29.

most of the troublesome rapids on our rivers, notably on the St. Croix, the Nepisiguit, and the Southwest Miramichi. Small falls of this type occur also commonly at the outlets of lakes, and at the lower ends of long dead-waters.

3. AFFLUENT FALLS.—In the process of erosion of any country, the larger, especially if sediment-carrying, rivers tend to wear down their channels more rapidly than do the smaller branches, especially if these be clear streams. This process may often have been aided by glacial erosion of the greater streams.* Hence, the smaller branches must enter the larger valley with a fall, which will not be a vertical drop, but an irregular sloping fall or rocky rapid. Very large branches would not show such a fall, since they would cut down as rapidly as the main stream. If now we note the way in which the smaller branches of our principal rivers enter the main valleys, we will find that it is usually with either a broken fall or else with rocky rapids. This is true, for instance, of most of the streams entering the St. John between Grand Falls and the head of tide above Fredericton. The phenomenon is less marked than it would otherwise be since the main river is, for the most part, not flowing in its ancient rock bed, but upon drift with which it is partially filled. Some of the falls at the mouths of these branches may be of glacial origin; indeed, they may all be, for the subject has not received, though it deserves, investigation from this point of view.

4. PLATEAU FALLS.—New Brunswick is largely of the physiographic character known as rejuvenated, that is, consists of great imperfect peneplains which have been re-elevated, thus allowing the rivers to cut their valleys deeply into them. On the resulting plateaus new streams are of course forming; and where these reach the valleys of the older rivers, they make a long fall into them, which may be steep even to vertical. Thus is produced, I believe, the highest fall in the province, namely, that on Fall Brook, on the southwest Miramichi, a few miles above Boiestown. This fall, 120 feet in height, and a single vertical drop into a beautiful rocky basin, occurs just where the brook meets the valley of the main Miramichi. The next highest, Hays, or Thompson's Fall, below Woodstock, is also of this character, as are the falls on the brook emptying Milnagek or Island

* Davis (Science, xiv, 779) appears to advocate the view that where such "hanging valleys" occur, the main stream has been deepened by glacial ice.

Lake into Long Lake, and innumerable other small ones in various parts of the province. Such falls will, of course, occur in their most typical form only upon very small and new streams. As those streams grow larger the falls will become reduced in height until they disappear, and they will pass through a stage in which they will merge with those of the preceding class.

Here also belong falls which occur where streams drop from a plateau to lower levels, even if these be not river valleys but have been formed by faulting or other method. Of this nature is probably the fall of ninety feet said to occur upon the stream emptying Lake Antonio into Sparks Lake in Charlotte.* Moreover, the many small falls on any streams coming from elevated land to lower levels belong partially here, but not entirely, for the mere slope alone would produce smooth sluices and not falls, and the actual fall comes rather under the next class.

5. EROSION FALLS.—Where streams are flowing down a sloping bed and cross bands of harder and softer rocks, they erode out the softer, forming falls over the harder. The same result follows where portions of the rock are met with, more jointed than elsewhere; these parts are more easily removed, leaving a fall over the less jointed part. Thus are formed many of the minor falls along the courses of our smaller streams, and especially along torrents flowing in rocky beds, such, for example, as the small rivers entering the Bay of Fundy between Quaco and Point Wolfe. By this method, also, falls formed in other ways are often given a more irregular character than they would otherwise possess. Usually falls of but a few feet in height are thus formed.

6. TIDAL FALLS.—Where heavy tides pour through narrow channels into large basins, there must be a considerable drop towards the water level beyond the barrier. If now in addition there is a shallow reef at the narrow place, the conditions are present for a true tidal fall; which may run inward with the rising and outward with the falling tide. Our best example of such a fall, and doubtless the best anywhere known, is that at the mouth of the St. John. Another of

* I have not seen this fall. It is mentioned in a pamphlet issued by the Magaguadavic Fish and Game Association, which states that Lake Antonio (locally Anthony) is 500 feet above Sparks Lake. An early plan by Holt gives it as 250 feet above Sparks Lake. All printed maps are in error in making this lake empty into Forked Lake; it empties into Sparks Lake, between Red Rock and Clear Lakes. The maps make it also far too small.

lesser perfection occurs in Cobscook Bay, and there are approaches to it in some of the passages in the Passamaquoddy region.

There may be yet other methods of formation of waterfalls not here considered;* and there lies open to us an attractive field for investigation, not only in the search for new types of falls, but also in the examination, description and reference to their proper types of all the leading falls of the province.

So far as concerns the economics of our water falls, it is plain that their value lies more in the past and future than in the present, for very few of them are now utilized, even of those which were once valued mill privileges. In the future, however, when fuel becomes dearer and methods of transmitting and storing power become improved, they are sure to rise again into lasting importance, and they may fairly be reckoned among the potential resources of the Province. It would be a great advantage from this point of view if exact data as to their height, volume, constancy and surroundings were available, such data as the United States Geological Survey has gathered for those of Maine.† Such data could best be secured as a part of the work of that thorough topographical, economic and scientific survey of New Brunswick which would be invaluable to the province in all of its greatest interests. The need for such a survey offers to some citizen of great wealth the opportunity to make to the province a gift of the most serviceable, lasting and satisfying character.

49.—The Origin of the New Brunswick Peneplains.

(Read June 4, 1901).

An important and very suggestive paper, entitled, "The Physiography of Acadia," has recently been published‡ by Dr. Reginald A. Daly, of Harvard University. The author deals chiefly with Nova Scotia, but refers also to New Brunswick, particularly its southern and eastern part. It is the object of the present note to inquire in how far his conclusions apply to New Brunswick as a whole.

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* Davis (Science xiv, 779, Nov. 1901), reviews a paper by Sturm on the origin of waterfalls. Two additional classes are recognized by Sturm, of which there are no cases known to me in New Brunswick. (1) Where side streams bring in boulders (as in the canons of Colorado), and (2) where travertine is deposited in a channel as in Bosnia.

† Nineteenth Report, vol. iv, 43-52.

‡ In Bulletin of the Museum of Comparative Zoology, Geological Series, v, 73-104.

As a result of evidence drawn from his personal observations, from a review of the literature of the region, and from a comparison with the well-known districts of New England, the author concludes that the surface of Acadia consists essentially of two great peneplains. The oldest of these, completed in the Cretaceous age, includes all the harder rocks, and hence the greater elevations, the surviving facets of which are the Southern Plateau of Nova Scotia, including all its central and southern parts, the North Mountain, the Cobequid Plateau, the Southern Highlands of New Brunswick, and, presumably, the Central Highlands also. This peneplain must once (according to current theories of the peneplain) have stood at or very near the sea level, to which, with the exception of some harder rocks remaining as monadnocks, hard and soft rocks alike must have been planed down by erosion. Then an elevation began, which, as the progressively greater height northward of the surviving facets shows, was much greater northward, carrying the New Brunswick highlands much higher than those of Nova Scotia, which on the southern coast of that province dip down beneath the sea. This elevation of the land permitted the rivers to begin again their work of erosion, and they proceeded to carve the peneplain. In the harder rocks they slowly cut deep channels, while in the softer rocks this was relatively quickly accomplished, and then lateral erosion began. A long period of stability followed in the Tertiary, during which the rivers (possibly with some tidal co-operation) carved the soft Carboniferous and Triassic rocks down to a new peneplain at sea level, or near it, thus giving origin to the second or Tertiary peneplain,* which includes the Annapolis Valley of Nova Scotia, the Colchester and Cumberland lowlands, and the great Eastern Carboniferous plain of New Brunswick. An elevation followed, permitting the rivers again to cut down deeply into these lowlands, as in many places they have done, and this was succeeded by a period of submergence, drowning many of the

* The fact that neither Cretaceous nor Tertiary formations occur in these provinces is not necessarily a fatal objection to the theory assigning those ages to the peneplains. According to the theory, the highest facets of the entire country would have stood near sea level at the close of the peneplanation in the Cretaceous; but since the newer peneplain is very much lower than the older, any deposits formed in the Cretaceous would necessarily have been eroded away before the erosion could affect the older rocks. Similarly we may suppose that any Tertiary rocks formed during the Tertiary planation of the newer and lower peneplain have since been washed away, or, more probably, lie outside of the limits of this peneplain, which in many places dips beneath the sea.

valleys, which brings us to the present. But the periods of elevation (and, doubtless, of submergence also), were accompanied by warpings of the surface, and this was of two kinds; first, warpings parallel with the Appalachian trend, one of which is responsible, in part at least, for the Bay of Fundy; and second, folding about a hinge line running through Cape Sable, Digby, and east of St. John, the part to the westward having a slight westerly slope.

We pass now to investigate the application of this conception of the two peneplains to New Brunswick. First, we have to consider the Southern Highlands, a range of ancient crystalline ridges and hills extending parallel with the Bay of Fundy from Charlotte to Albert counties. Its extreme elevations reach about 1,400 feet, but the general elevation is very much less. I have not had the opportunity to observe these Highlands with the peneplain idea in mind, but in one position, at least, I recall that a distinct facet of the Cretaceous peneplain of Nova Scotia is finely shown, namely, in the great plateau, some 600 to 800 feet above the sea, extending from near Quaco to Point Wolfe, several miles broad and merging northward with the greater heights which are either monadnocks of the ancient peneplain, or are a result of subsequent warping. Again, another facet probably occurs in Douglas Mountain and the Broke-Neck-Blue-Mountain ridge, over which Mount Champlain (Bald) rises as a monadnock. No doubt other facets will be found.

North of these Highlands lies the great central Carboniferous Basin, which consists, for the most part, of soft sandstones, which have an elevation west of the St. John of 300 or 400 feet above sea level, and slope off gradually, with some local monadnocks and anticlinal warpings, to the eastward, where they dip evenly beneath the sea. The rivers, particularly the St. John, have cut deeply into it. As Daly himself points out, this basin falls in perfectly with his idea of the Tertiary peneplain. It is an extension of this peneplain which forms the great flat area in south-western York County, a typical peneplain from which rise a number of marked monadnocks, Mount Henry, Mount Prospect, Magaguadavic Ridge, Cherry Hill, Wedawamketch, etc, representing remnants of the earlier peneplain.

We pass next to the Central Highlands. This range lies north-east and south-west, entering the Province south of the Aroostook and Tobique, extending between Tobique and Miramichi, and across

the Nepisiguit to Bay Chaleur near Belledune. It is composed of the same ancient crystalline rocks as the Southern Highlands, but rises to extreme heights of 2,600 to 2,700 feet, with a general elevation considerably lower. In two places I have recognized beautiful facets of ancient peneplains. The first is in the level plateau, 1,700 to 1,800 feet above the sea, which exists between the headwaters of the Right Hand Branch of Tobique and the headwaters of the Little Southwest Miramichi (compare Note 55.) As seen from Long Lake on the Tobique, or from the Big Lake on the Miramichi, it presents the aspect of an extensive flat-topped ridge, which is shown upon nearer acquaintance, especially by crossing it, to be a rolling plateau. Fragments of it exist off to the eastward in Mount Braithwaite and ridges along the Little Southwest River, and to the southward of the Crooked Deadwater.* I have no doubt that this is one of the facets of the same great peneplain which Daly describes as the Cretaceous peneplain of Nova Scotia, and further study will unquestionably show that it has a much wider extension in this region. Its height is little greater than required by the angle at which it slopes upward in Nova Scotia and the Southern Highlands. Second, the Governor's Plateau, which I described in an earlier note (No. 29) without at all understanding its significance, appears to be a very typical facet of a true peneplain. It stands, however, at a higher elevation, some 2,400 to 2,500 feet. One at first inclines to consider that it is a fragment of an earlier peneplain, but, recalling the present high elevation of the Silurian plateau, presently to be spoken of, we see that it is doubtless due to the upwarping which this region must have undergone, and which, probably, explains in part the height of the plateau between Tobique and Miramichi, already considered. The mountains centering in Bald Mountain on the South Branch of the Nepisiguit probably represent another facet of the same peneplain similiarly upwarped, but these stand also on the hinge line of the greatest elevation, presently to be referred to.

North and west of these central highlands lies the great Silurian plateau, a fine type of a peneplain, of undulating surface, some 800 to 1,000 feet above the sea, composed of soft Silurian rocks, into which the Tobique, St. John, Restigouche and other rivers have deeply cut. This answers perfectly to Daly's younger or Tertiary peneplain in

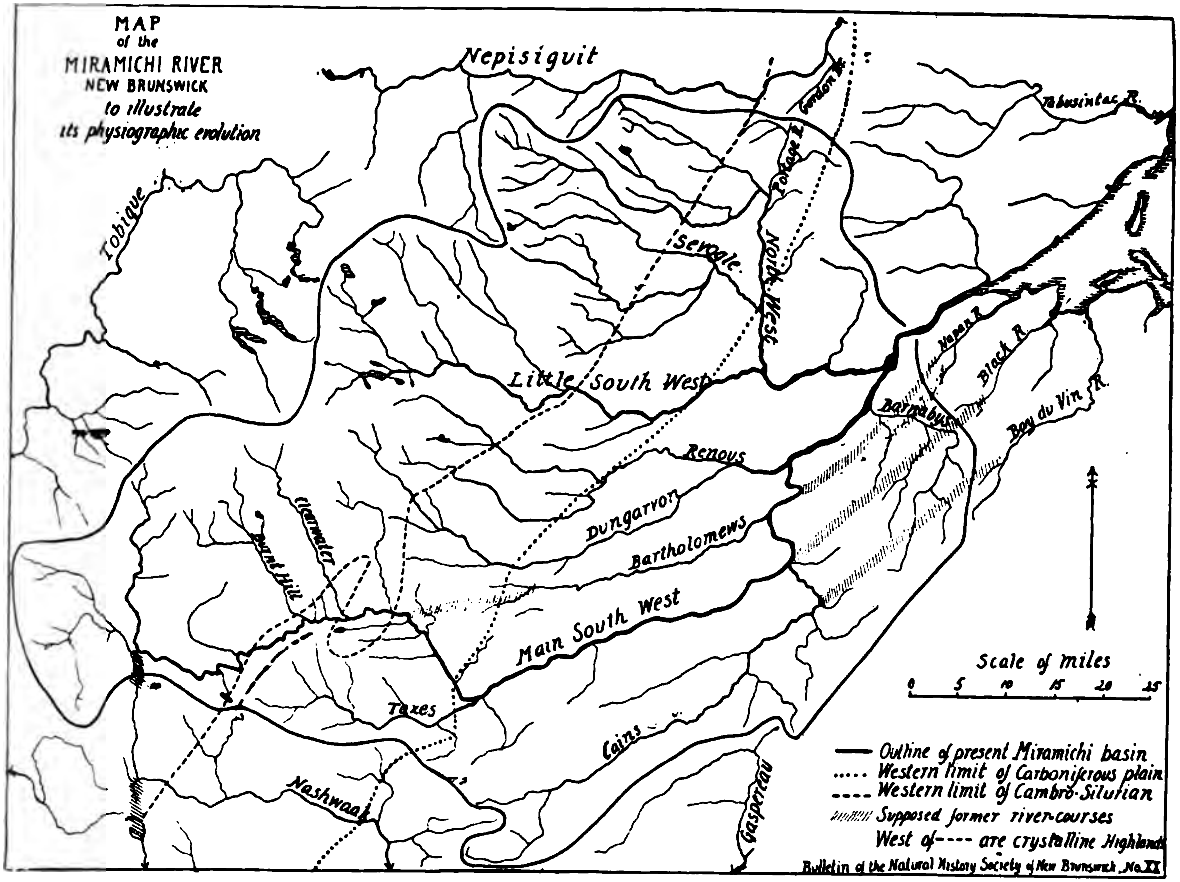
* I expect later to continue the study of this peneplain, and to present a map of it.

every respect, except in its greater elevation, which, however, is readily explained by an upwarping of this region. Unlike the central Carboniferous plain, it does not slope off to the eastward, but holds its height to near the mouth of the Restigouche (if, indeed, it does not slope slightly thence to the westward), whence it falls off relatively rapidly to Bay Chaleur. Why, now, does this plateau not slope to the eastward when its contemporary, the Carboniferous plain, does so? Here Daly's suggestion as to warping about a hinge line extending through Cape Sable, Digby, and east of St. John, is most important. If, now, that line be continued in a northerly direction, it will pass over the eastern end of Grand Lake (through the highlands occupied by Marr's and Emigrant Settlements),* through the highest part of the Central Highlands, and across the mouth of the Restigouche River.† This would represent an anticlinal uplift from which the old peneplain sloped on the one side to the eastward (thus explaining the slope of the Carboniferous plain), and on the other to the westward (thus explaining the lack of easterly slope in the Silurian plateau). But it explains many other facts as well, of which the most important are these, that the St. John has been turned south from its proper morphological course into Bay Chaleur, and that the Tobique runs southwest instead of northeast (Note 45); and further, that the St. John, after thus reaching the Carboniferous basin, does not follow it to the sea, but continues southward into the Bay of Fundy. It perhaps explains also the turning of the Miramichi southward from its course into the Dungarvon to the Taxes, near Boiestown (Note 50).

Such a syncline usually is accompanied by corresponding anticlines, however, and one of these we doubtless have in the great trough occupied by Nepisiguit Bay, the Lower Nepisiguit, the north and south part of the Northwest Miramichi, and the right-angled bends of the main Southwest Miramichi. East of this appears to come another anticline, followed by a syncline, forming Northumberland Straits, while another anticline forms the higher lands of Prince Edward

* Independently of Daly's suggestion as to the anticlinal hinge line, I had previously come to the conclusion that the ancient watershed east of the lower St. John was at the head of Grand Lake, that most of Salmon River formerly flowed into Richibucto (whose morphological head was Salmon Creek, west of the Gaspereau), and much of the Canaan into the Buctouche (whose morphological head was Prices Brook), a subject to which I shall return in a future note.

† Possibly the south branch of Nepisiguit and the Upsalquitch may occupy the crest of this anticline.


MAP
of the
MIRAMICHI RIVER
NEW BRUNSWICK
to illustrate
its physiographic evolution
Nepisiguit
Tabusintac R.
Tobique
Gordon R.
Portage R.
Sevogle
North West
Little South West
Napan R.
Black R.
Bay du Vin R.
Barnabys
Renous
Dungarvon
Bartholomews
Clearwater
Burnt Hill
Main South West
Taxes
Cains
Nashwaak
Gaspereau
Scale of miles
0
5
10
15
20
25
Outline of present Miramichi basin
..... Western limit of Carboniferous plain
---- Western limit of Cambro-Silurian
Supposed former river-courses
West of ---- are crystalline Highlands
Bulletin of the Natural History Society of New Brunswick, No. XX

MAP No. 2.

Island. As to the age of this hinge line, we are at present in doubt, but it is likely that further studies will determine it, and tentatively we may assign it to the period of the uplift of the Cretaceous peneplain, though it may be a cycle later.

It remains to notice the warpings parallel with the Appalachian trend.* As already mentioned, one of these probably helped to form the Bay of Fundy; the Southern Highlands owe, probably, a part of their height to an upwarping, while the Carboniferous plain along the Richibucto–Grand–Lake–Oromocto axis, and again in the part occupied by the Miramichi river, represents either one, or, perhaps, more, synclinal downwarpings. An extensive upwarp raised the Central Highlands and the great Silurian plateau, and these Central Highlands perhaps owe their height to the fact that they stand at the intersection of the two great lines of upwarping (the one parallel with the Appalachian trend, and the one at right angles), while on the other hand the great depression of the region where the branches of the Southwest Miramichi come together (and, indeed, the peculiar manner in which they come together), may be due to the fact that that region is at the intersection of two lines of synclinal warping. If the cross warping parallel with the great hinge line followed the elevation of the Cretaceous peneplain, probably the longitudinal warping accompanied the elevation of the Tertiary peneplain, but the reverse may be the case.

In a general way, then, Daly's theory applies well to New Brunswick, and it will form a valuable working hypothesis. Much investigation will, however, be needed before it can be either on the one hand applied in detail, or on the other, disproven.

50.—The Physiographic History of the Miramichi River.

(Read June 4, 1901.)

In earlier notes of this series (Nos. 33, 37, and 45) the attempt has been made to trace the probable physiographic evolution of the Nepisiguit, Restigouche, and Tobique rivers; a similar treatment of the Miramichi here follows. It is, of course, plain that the deductions

* It is of interest to notice that the axes of these warpings and of the crystalline rocks do not coincide. Thus the axis of the crystalline rocks is on a line drawn from Belledune point to the mouth of Eel River, in Carleton County, but the axis of the greatest upwarping is on a line from Mars Hill to Miscou Island. Thus the branches of the Southwest Miramichi are strictly parallel with the warpings, though not with the crystalline rocks.

set forth in these notes often rest upon very scanty data; and they are to be viewed, therefore, not as matured conclusions, but rather as tentative hypotheses suggested by the known facts and needing the test of further investigation.

The Miramichi is remarkable for the great number and regular radiation of its large branches, which, considering its mouth as at Beaubair's Island, cover at least 260° of a circle. As the geological maps, or the accompanying sketch (Map No. 2) will show, most of its branches rise in the Central Highlands, flow eastward to the Carboniferous plain, uniting as they go, to fall by a single trunk into the sea. This Carboniferous plain is a peneplain of three or four hundred feet elevation in its western part, where the rivers have cut deeply into it, but it dips gradually to sea level towards the east. It is composed of Carboniferous strata which are mostly nearly level, and hence have been little disturbed since their formation.

For physiographic study the river falls naturally into three portions; (1) the Northwest, (2) the Little Southwest, and (3) the Main Southwest.

We consider first the Northwest. This river shows two parts; first, the numerous streams rising far back in the wild, uninhabited Highlands amid high felspathic and granitic hills, and flowing eastward in deep valleys over rough beds, converging as they go;* and second, the trunk stream running from north to south, collecting their waters to pour them into the Little Southwest. As to the origin of the former streams, they must at least go back to the Cretaceous peneplain of which the Highlands are probably remnants (see Note No. 49 preceding), and very probably they are much older and represent streams which helped in the planation of that peneplain before its post-Cretaceous elevation. They run now from their sources

* As laid down on our maps, there is a most astonishing resemblance between the two great western branches, the Main Branch and the Sevogle. Taking the Geological Survey map, for instance, we note that both rivers enter the north and south part at about the same angle. Some miles (though at different distances) up both divide into branches, striking off at similar angles. Taking the north branches, both give off small ones to the south and then fork into approximately equal streams. Taking the south branches, both fork at about the same distance, and these branches are not unlike in the two cases. So remarkable is this resemblance that we must conclude either there is here some extraordinary coincidence, or that the two rivers have been laid down from sketches intended to apply to the same river. The two streams are little more unlike that would readily be explained by two traverse surveys of the same river. The chief difference consists in the greater distance of the first branching of the one than of the other from the main river.

to near their mouths in pre-Carboniferous formations, but no doubt, in the lower parts of their courses at least, they formerly ran over Carboniferous rocks, the removal of which has let them down upon and into the older strata. It is very possible that the most ancient contact line of Carboniferous and earlier strata (in the shore line of the Carboniferous seas) occurred at the places where these branches now unite and abruptly change their direction, somewhat west of the present contact line.* The possibility that some of the Nepisiguit branches once formed a part of this system has been considered in an earlier note (No. 33.)

We pass next to consider the north and south valley of the Northwest, which is very remarkable for the way it cuts across nearly at right angles to the directions of the western branches. Its true morphological head is unquestionably Portage River, from which a low portage leads into Gordon or Portage Brook, a branch of the Nepisiguit. All these streams (Miramichi, Portage River, Gordon Brook and Lower Nepisiguit) are practically nearly in a line, and occupy a single great north and south trough or depression with much higher ground both east and west; and the same influences, therefore, whatever they were, appear to have determined the Lower Nepisiguit and the north and south part of the Miramichi. If now we seek an explanation for this great depression, we at once conclude that it cannot be a great valley of erosion, but must rather represent a synclinal trough due to earth warping. To the eastward the Carboniferous rocks rise to a height of over 500 feet above the sea, in consequence, as Ells states,† of a great anticlinal uplift represented by "the high ridge that extends eastward from the vicinity of Bartibog station on the Intercolonial Railway." As mentioned in the preceding note, this elevation is probably a continuation of the anticline which extends through the New Brunswick highlands, and the question arises: How originated the depression extending right across this anticline? Here, no doubt, the explanation is to be found in a synclinal depression parallel with and corresponding to the anticlinal hinge line extending from St. John to the mouth of the Restigouche, mentioned in the preceding note, forming a trough here well marked, and tending to

* The Carboniferous rocks are here fringed by a narrow band of Lower Carboniferous not included within the boundary drawn on the accompanying map.

† Geological Report, 1882, D. 3.

disappear southward. It is possible that before this trough was formed, all the western branches in question, together with the main Nepisiguit, flowed across the country to empty into the sea where the Pokemouch, Tracadie and Tabusintac now do.

We pass next to consider the Little Southwest Miramichi. The part of this river from Beaubair's Island to Red Bank is commonly called a part of the main Northwest, but it seems plain that it belongs to the Little Southwest physiographically, and we shall so consider it. The general history of this river seems comparatively simple, but it is complicated in detail, as will be shown in a later note. It rises with numerous large branches in the heart of the highlands, and flows with a great fall (1,100 feet and more) in a deep and winding valley over a very rocky bed eastward to the sea. It represents, perhaps, the morphological axial river of the entire system.

We consider next the Main Southwest and its branches, excluding at first the part above the Taxes, the latter river being no doubt the morphological head of the main river. This part of the Miramichi consists of a series of nearly equal rivers running nearly parallel with one another, but brought into one stream by a remarkable series of right-angled bends (compare Map No. 2). Examining these rivers more closely, and passing upward from its mouth, it is quite plain that the Renous (perhaps including its branch, the Dungarvon) forms the true morphological head of the part of the river below it, while what is now the main river comes into it as a side branch. Passing up the main river, it swings again to the west, and here plainly the Bartholomew is its morphological head, while again the main river is morphologically but a branch. Passing farther up the main stream, it again swings to the west, and soon after Cains river comes into it precisely in the same manner as it fell into the Bartholomews and the combined streams into the Renous. Small branches of Cains river appear almost to attempt to continue still farther the remarkable arrangement,* while it is very probable the upper Gaspereau emptied by the west branch of Sabbies River into Cains River. Were the part of the main river above the Taxes wanting, it is plain that Cains would be the main and largest stream. All of these branches, except Cains

* Indeed, one is inclined to think it possible that the Upper Nashwaak above Cross Creek may once have flowed by Cains River into the Miramichi, a theory by no means without facts in its support.

river, rise in the Pre-Carboniferous highlands, and all show a change of direction near the line of contact between Carboniferous and Pre-Carboniferous, which must have some physiographic meaning; and the parts of these rivers flowing over the Carboniferous plain have cut well into that great peneplain, which rapidly falls in elevation to the eastward. What, now, is the explanation of the remarkable right-angled bends which thus throw these several independent streams into one trunk? We notice, first of all, that the general line of these bends is nearly that of the trunk valley of the Northwest, and this suggests that they lie in the same synclinal depression, which is probably the case. Moreover, it is likely this part of the Miramichi occupies a great trough parallel with the Appalachian trend (see preceding note), so that another influence has aided in throwing them together. In any case, however, their direction and parallelism suggests that they formerly (*i. e.* on the Tertiary peneplain) emptied independently into the sea to the eastward, following an even slope of the little disturbed Carboniferous strata. Indeed, it is possible that traces of such an arrangement still exist, for our maps* show a remarkable arrangement of rivers to the eastward. Barnabys River cuts straight back from the lower Miramichi and has long branches from the westward, which are approximately in line with the Miramichi branches, while still farther to the eastward the Napan, Black and Bay du Vin rivers continue the same lines. It seems possible, therefore, that the Bartholomew, the main Miramichi and Cains river formerly flowed along the present branches of Barnabys River, and along the Napan, the Black and the Bay du Vin rivers independently into the sea, but that the synclinal warping of the Tertiary peneplain (aided perhaps by fault lines) threw them into one another, while Barnabys River, flowing down the slope of the trough of Appalachian trend, has cut back and bisected their lower courses.

We consider next the part above the Taxes. That the Taxes is the morphological head of the lower river, there is, I believe, no doubt. This part of the Miramichi is the most puzzling of all. Proceeding first to its head, we notice that its upper course runs nearly south, until, at the junction with the western branch, it turns abruptly to the eastward. But exactly in line with this upper part of the

* Unhappily, the lack of accurate maps is a well-nigh insuperable obstacle to more than speculative conclusions in such studies as these.

river, and separated from it by only a short interval, lies the upper part of the Nashwaak Valley,* while still further south in the same line lies the low land at the head of the Becaguimec and Keswick rivers. I believe, therefore, that there existed here an ancient river valley which emptied southward, and which has been beheaded by both the Miramichi and the Nashwaak. The remainder of the part of the river above the Taxes flows at first in a rather open country, but soon cuts deeper into it; the valley becomes winding, narrow and with a very rocky bed, until below Rocky Brook it bends nearly at right angles to flow into the main river. We notice, however, that this part of the river is in line with the Bartholomews (or possibly the Dungarvon), and it seems most probable that it formerly was the continuation of one of those rivers, thus preserving the parallelism of the entire series. The change of direction, as we have seen, may be connected with the hinge line passing north and south just to the eastward. All this part of the country was, probably, once covered by the Carboniferous sediments presenting their regular slope to the eastward, and their removal has let down the river into the underlying older formations, explaining its present course across them.

So much for the more ancient history of the river; what effect upon it had the glacial period? Aside from several minor gorges and falls (of which a particularly fine one is described by Ells upon the Main Northwest, above Stony Brook †), the filling of valleys with drift and the formation of some small lakes, I have not been able to trace any important influence, though field study will, doubtless, reveal other glacial influences. The river has no great waterfalls anywhere upon its main branches, though it has innumerable rapids.

The Miramichi, therefore, has had a comparatively uneventful development. The great Cretaceous peneplain must here have had an even easterly slope, explaining the parallelism of the numerous branches, which, by warpings during the peneplanation of the Tertiary peneplain, were considerably altered in direction and thrown together. The river has lost some of its old waters, perhaps to the Nepisiguit, to the Gaspereau, and possibly to the Nashwaak; it has gained from the ancient Keswick; its upper part has been transferred from one of its branches to another, and some of its lower branches have been changed from independent courses into a single trunk.

* The Nashwaak Mountain placed at this angle on the Geological Survey Map is out of place.

† Report 1881, 29 D.

51.—On a Lunar Rainbow Seen on Trowsers Lake.

(Read Nov. 5, 1901.)

The lunar rainbow is a not infrequent phenomenon, but a remarkably perfect example, seen by Mr. M. I. Furbish and myself at Trowsers Lake on the evening of August 3rd, 1901, may be worth mention. About ten o'clock, a light shower with fleecy clouds came up opposite to the waning but bright moon, and against the clouds appeared a very perfect bow with the arch complete. No colors were visible, but instead the bow was of grayish light, not unlike the northern streamers.

52.—On an Unusual Frost-effect of 1901 on the Tobique.

(Read Nov. 5, 1901.)

In the valley of the Tobique and elsewhere in central New Brunswick the firs and spruces in August last (1901) arrested attention by the remarkable appearance of the tips of all their branches. The new growth of the year, from two to four inches in length, hung downward, brown, withered and dead. I was informed, no doubt correctly, that the destruction was caused by a severe frost during the first week in June. I noticed that many of them were sprouting again behind the dead part, and usually by two buds on opposite flanks of the branch. The growth of these trees for 1901, therefore, is likely to be marked for the future, both by its shortness, and also by the unusual amount of bifurcation in the branches, features which may puzzle the student unless he knows the true cause.

53.—On a Hypsometric Section Across Central New Brunswick.

(Read Nov. 5, 1901.)

In August last, in company with Mr. M. I. Furbish, I crossed New Brunswick from the Tobique River to the mouth of the Miramichi, by way of Trowsers, Long, Milnagek (Island), Little Southwest (Tuadook) Lakes, and the Little Southwest Miramichi River. Careful aneroid measurements were made throughout the trip, after the methods and with the results described below. The great majority of the places mentioned have not hitherto been measured for elevation.

INSTRUMENTS.—We had with us, and read constantly, three aneroids, a small one belonging to Mr. Furbish, another of my own which has been used in making the measurements communicated in previous years to the Society, and a new Watkin Mountaineering Aneroid made by Hicks of London (No. 117, 4½ inches in diameter.) This instrument, possessing a new device which entirely overcomes the "creeping" error inseparable from the older forms, is the best aneroid now manufactured. It was tested for me just before the trip by Dr. Harrison at Fredericton, and, although at first it seemed to give a considerable error, it was later found that this was due to an improper mode of reading it, and when correctly read it gave no measureable error. After the trip it was compared by Mr. Hutchinson with his standard instrument at St. John, and found to be without appreciable error. Moreover, it has since been examined by its maker, Hicks, who reports it in perfect order. It was found to be more sensitive than either of the other instruments, and hence its readings alone have been used in making the following calculations, though the readings of the others have been used as a check.

COMPARISON BASE.—For this I have used the Fredericton station from the beginning of the trip until Little Southwest Lake was reached, *i. e.* August 2nd to 19th, and the Chatham station from August 14th to September 2nd. For lists of readings from the two stations, I wish to express my thanks to Dr. Harrison and to Mr. J. F. Connors, the dominion observers at the two stations. Both stations are too distant to form satisfactory bases (both being about sixty to seventy miles from the principal places measured), this distance allowing of considerable error due to difference of weather conditions between the places measured and the stations. To lessen this error (or indeed to eliminate it), I have devised the following method, which applies, however, only where several measurements are made of the same locality : The station readings were plotted as polygons (curves), in which the abscissæ were the dates and times of reading, and the ordinates (made long to bring out slight variations) were the barometric readings. Over these my own readings were plotted upon the same scale, but with the first reading superposed over the first base-station reading. It is now obvious that, if the weather conditions at base-station and the places measured are identical, and the barometers read alike, the curves should be coincident throughout, and that the

deviation from coincidence will afford a measure of the variation in weather conditions between base-station and place of observation. Local weather-changes are thus brought out with great clearness. One can therefore eliminate all readings showing a marked deviation from this coincidence and retain only those in which the base-station reading gives a correct index of the weather changes. This method is, of course, only applicable where several measurements are made of the same locality, and in such cases I have applied it in the calculations yielding the results below, selecting from my total number of readings only those which are thus shown to be the best.

METHOD.—The readings were in nearly every case made at the exact minute when the barometer was being read at the Fredericton station, and the temperature was recorded at the same time. The results have been worked out by Airy's tables and with his formula for allowance for temperature. In the case of the readings compared with Chatham, however, owing to a misunderstanding of the time at which they were to be taken, our readings are some minutes earlier (Chatham taken at 7.50, 2.50 and 7.50, ours at 7.24, 2.24. and 7.24, standard), and hence they are, theoretically, less accurate than the series compared with Fredericton, though the error would be very slight, especially where several readings are averaged.

PROBABLE ACCURACY.—The instruments and methods used, and the care exercised in all observations and calculations are such as to make me feel confident that the following measurements are as accurate as aneroid measurements can be made with Fredericton and Chatham as base-stations.

RESULTS.—The following figures express heights above mean-tide level at St. John. Unless otherwise specified, the places have not been measured before.

Trowsers Lake. Mean of two measurements, 1,286 feet. Chalmers gives (Summary Report for 1900) 1,350, and McInnes (Geological Map) 1,360 feet, both, in my opinion, impossibly high. Concerning my own lower result of last year (viz.: 1,243) some observations will be given below.

Long Lake.—A single measurement, 1,302 feet, probably too high. Mr. Chalmers makes Long 30 feet lower than Trowsers, which seems to me incorrect. McInnes made it 10 feet higher, and I made it 13 feet higher last year, and 16 feet higher this year.

Milnagek (Island) Lake.—Mean of seventeen good measurements 1,584 feet. The only previous measurement of this charming lake is my own of last year, 1,510 feet, concerning which remarks are made below. I made this lake by direct measurement this year 260 feet above Long, which seems to imply that 1,584 feet is somewhat too high.

Just east of Milnagek lies *Squaw Lake*, a small shallow lake 175 feet higher by direct measurement, and hence 1,659 feet, the highest lake yet measured in New Brunswick.

Watershed Plateau—(a remarkable facet of the ancient "Cretaceous" peneplain) between Island and Little South West Lakes. Mean of four measurements with Fredericton as a base, gave 1,725 feet with 1,768 feet as the highest point reached by us. With Chatham as a base, the average of four measurements is 1,667 feet, with 1,697 feet as the highest point. The discrepancy in these results will be discussed below.

A small lake on this plateau must be between 1,725 and 1,750 feet, the highest noted in the Province.

Little Southwest Miramichi, or *Tuadook Lake*, also known as *Big Lake.*—Mean of five measurements, with Fredericton as a base, gave 1,161 feet; with Chatham as a base the same five measurements gave 1,126 feet. The mean, however, of thirteen measurements compared with Chatham is 1,136 feet. Ells measured this lake some years ago, and gave its height as about 1,200 feet.*

The Crooked Deadwater at the head of the Little Southwest Miramichi River is by direct measurement about 175 feet above the Big Lake, and hence about 1,311 feet.

Pocket Lake is about 10 feet above Big Lake, and hence 1,146 above the sea.

Holmes Lake is about the same height as Big Lake.

Jacks Lake is by estimation (based upon the small drop from it to its junction with the main river in comparison with the large drop in the main river from the lake to the junction) about 1,100 feet.

Junction of the West Branch with the main stream. Mean of three measurements, 1,052 feet. This makes the drop from the lake only 84 feet, which appears rather small.

Big Deadwater at junction with the Main North Branch. About 30 feet above the latter, and hence 1,082 feet.

* Report 1881, 32 D.

River at beginning of bad rapids above Indian Brook. Mean of two measurements, 1,045 feet.

River two miles above Mains Brook. Mean of two measurements 828 feet.

River in the principal gorge below Mains Ledges and above Libbys Brook. Mean of two measurements, 566 feet. At this place the river has cut deeply into a great peneplain, which by direct measurement here lies from 230 to 250 feet above the river, and hence about 800 feet above the sea.

River just above Devils Brook. Mean of two measurements, 328 feet.

River just above Red Stone, a single measurement, 180 feet.

River ten miles above Red Bank. Mean of two measurements, 94 feet.

Sea level is reached about two miles above the junction with the Northwest Miramichi.

The general physiographic significance of these results will be discussed in later notes to be offered to the Society. I shall here refer only to two points connected with the measurements themselves. First, my own measurements for Trowsers, Long and Milnagek Lakes are higher this year than last. I am convinced that those of this year are more accurate. My smaller aneroid, I am pleased to find, runs remarkably well with the new Watkin, but it lingers a little behind it on the changes. Moreover, I find that in previous calculations I have not made a sufficient allowance for air-temperature, the introduction of which in summer measurements always gives greater heights. I believe, however, that all of my earlier measurements, if absolutely a few feet too low, are yet correct relatively to one another. Second, where calculations have been made with both Fredericton and Chatham as bases, the heights obtained with Fredericton as the base are considerably higher than those from the Chatham base. I had a similar experience some years ago in comparing readings from the Fredericton and St. John stations (see this Bulletin, XVI, 63), and I then suggested that the height of 164 feet assigned to the Fredericton station might be somewhat too great. This appears to me to be the most probable explanation of the discrepancy shown by the results of this summer. It would be a satisfaction if the height of the Fredericton station could be re-determined, since, if in error, it not only vitiates all past measurements, but will continue to vitiate measurements to be made for many years to come.

54.— On the Physiographic History of the Little Southwest Miramichi River.

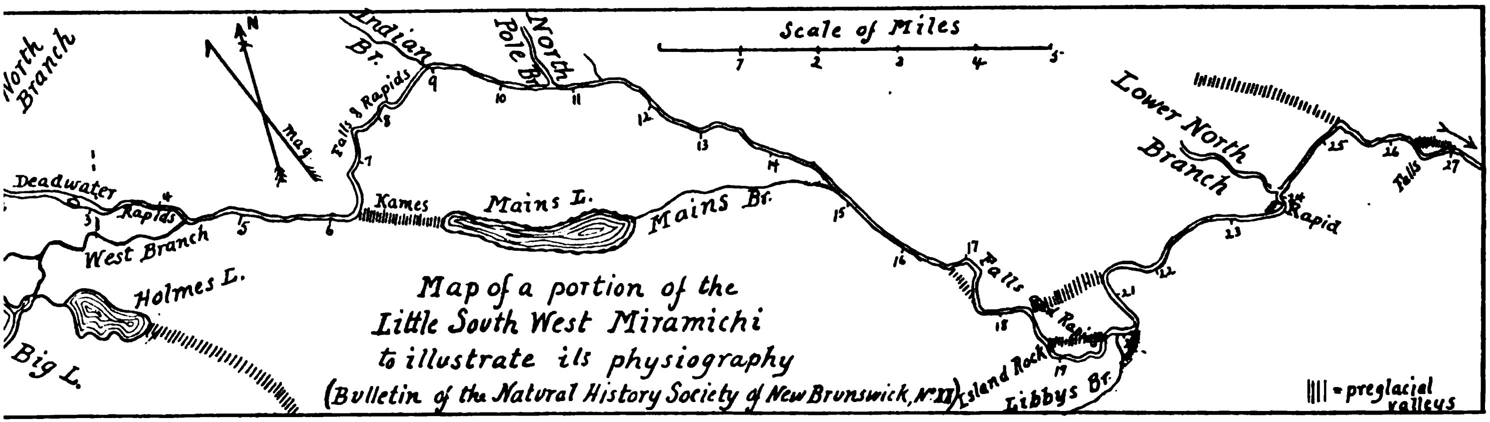
(Read November 5, 1901.)

The Little Southwest Miramichi is noted among guides and lumbermen as the roughest river in all New Brunswick. It is consequently one of the least visited and least known, although it has some of the wildest scenery, and is one of the richest in game and fish, in the province. I have been along its entire length from the Crooked Deadwater to its mouth,* and have made the following observations upon its physiography :

Its general physiographic origin and earlier history have been traced in brief in an earlier note (No. 50). It is one of that series of branches of the Miramichi, all having a history in common, rising in the ancient crystalline highlands of the province and flowing eastward across various formations, cutting deeply into all of them. It is its later quaternary, especially glacial, history which is now to be considered. The subject is illustrated by the accompanying map, No. 3.

There is no question, I believe, that the group of lakes which we are accustomed to consider as the source of this river (viz., the Little Southwest Lakes) belong morphologically to the Renous system, and have only a post-glacial (or, at all events, very late pre-glacial) connection with the Little Southwest Miramichi, by the very rough stream between the lakes and the main river (West Branch), a conclusion reached as a result of evidence to be presented in the next note of this series. The true morphological head of the Little Southwest Miramichi lies eastward of Long Lake, of the Negoot group, and the Upper North Branch is a true morphological branch, even though it exceeds the main stream in size. Possibly, like some other branches larger than their main streams, its headwaters have been captured from some other river, a subject still to be investigated. I have myself been only a mile above the junction of the Upper North Branch and the Main River; here the river, 1,082 feet above the sea, is a deadwater for three miles or more, below which, to the junction with the West Branch, it falls some twenty-five to thirty feet through a series of boulder trains across its course, evidently the remains of old glacial dams. From the West Branch, 1,052 feet above the sea, down to the six and one-half mile turn, and somewhat beyond, the river

* In company with Mr. M. I. Furbish, in August, 1901.



Map of a portion of the
Little South West Miramichi
to illustrate its physiography
(Bulletin of the Natural History Society of New Brunswick, No XI)
Scale of Miles
North Branch
Deadwater
Rapids
West Branch
Holmes L.
Big L.
N
Mag.
Indian Br.
Falls & Rapids
North Pole Br.
Kames
Mains L.
Mains Br.
Falls
Island Rock
Libbys Br.
Lower North Branch
Rapid
Falls
||| = preglacial valleys

Map No. 3.

flows swiftly, but smoothly, and the whole aspect of this part of the valley from above the Upper North Branch is that of an ancient ripened, though drift-bottomed valley. At the six and one-half mile turn the river bends abruptly northward; the country happens to be burnt, affording an excellent view of the surroundings, and here, extending off to the southeastward, in the line of the course of the river above, is a series of unmistakeable kame-hills of the typical form and appearance. Less than a mile below this turn, at an elevation of 1,045 feet or less, begin the bad rapids and falls which have made this river famous. Here the river narrows and falls over granite ledges and through small gorges with vertical granite walls. The whole aspect of this stretch to Indian Brook is typically post-Glacial. Below Indian Brook, to the North Pole Branch, the river continues rough, though not in so marked a degree as above. At the North Pole Branch the character of the river changes, and it becomes broader, more open, comparatively easy and pleasant for canoeing, with a continuous slope, but no bad rapids and no falls. This character continues to the mouth of Mains Brook, and beyond it to near seventeen mile bend. Evidently all the river from the North Pole Branch to the seventeen mile bend runs in an ancient well-ripened valley, and the part between Indian Brook and the North Pole Branch seems somewhat older than the obviously post-Glacial part above Indian Brook. The interpretation of these facts might be difficult enough were it not for another brought out by the maps,* namely, that in a line between the six and one-half mile bend and the mouth of Mains Brook lies the valley occupied by Mains Lake and Brook. All these facts taken together seem to point to but one conclusion, namely, that in pre-Glacial times the main river flowed through the present valley of Mains Lake and Brook. The kame hills at the six and one half mile bend constitute the great glacial dam which turned the river aside and sent it over a low part of its valley to fall by a post-Glacial channel into the valley of Indian Brook, then a small branch of the North Pole Branch. It followed this valley, which it is now enlarging, to its junction with the North Pole Branch, then a large stream which fell into the old main river at the mouth of the present Mains Brook. It

* For all the facts of topography referred to in this paper, the original very detailed survey map of 1836, by Berton, is much more valuable than the modern imperfect compilations from it.

will be noticed, further, that the directions in which all these streams flow, and in which they enter one another, are fully consistent with this interpretation.*

Down to the North Pole Branch there are few hills near the river, and the first lofty hills appear just below that branch, on both sides of the river. They appear to be well up towards 1,000 feet above the water and to form part of a ridge crossing the river and separating the North Pole from the Lower North Branch. This range is exactly on the hinge line described in the preceding note. Eastward of this ridge the country appears to fall away to a great plateau, a true peneplain, which slopes off to the sea.

Just above the seventeen-mile bend, the falls and rapids suddenly begin again, and the river falls over crystalline ledges for half a mile, at the foot of which is a typical small gorge and pool. Here again the valley seems typically post-Glacial, and although I did not trace out a pre-Glacial valley, I suspect that one exists in the direction shown by the shading on the map. Below this the river is not so rough for a mile, this part being, doubtless, the ancient valley; but at Island Rock begins the worst series of rapids and falls on the entire river. Here the river falls over rocky ledges, into which it has cut small gorges, a very typical example of which occurs at the foot of the series. The whole aspect of this part of the river bed is typically post-Glacial, but yet it is very difficult to interpret it in that way. The valley here is V-shaped, with the walls of great irregular angular masses of rock, cut by actual measurement about 250 feet below the surface of the great rolling plateau, or peneplain, of which this region is constituted. There appears to be no room in the valley for a pre-Glacial channel around these present ledges and falls, and yet it is equally difficult to imagine that it lies outside of the present valley; for the amount of work required to cut down the present valley to such a depth in such hard rocks appears too great to have been accomplished in post-Glacial times. If, however, this has happened, the pre-Glacial channels would have run in one of the directions indicated by the shading on the map. More detailed study than I could give the question will, no doubt, settle it. At Libbys Brook (566 feet above the sea), which enters the main valley by a lofty post-Glacial fall, the character of the

* It is quite possible that the North Pole Branch emptied earlier at the angle to the eastward of its present mouth, where a small brook now is.

river changes again, and, especially at the twenty and one-half mile bend, it assumes the gentle slope and drift-bottomed character of an old valley. This matured character becomes yet better marked below the twenty-one and one-half mile bend. At the twenty and one-half mile bend there appears to be an old valley entering the main river in the line of the stretch between twenty and one-half and twenty-one miles, and this, I believe, was the pre-Glacial mouth of Libby's Brook. If now, the pre-Glacial channel ran as shown on the map, the part of the valley from the twenty and one-half mile bend to the twenty-one and one-half mile bend must have been in pre-Glacial times a part of Libbys Brook. At these falls the ancient peneplain character of the country is very marked. The line between plain and river valley (viz., the rim of the valley) is sharp and level. By actual aneroid measurement this plain here lies about 250 feet above the river, and hence 800 feet above the sea.

From the twenty-one and one-half mile bend to the Lower North Branch the river is pleasant and more open, with a steady slope, but no bad rapids nor falls. Just above the Lower North Branch is a small rocky rapid, evidently post-Glacial, and the pre-Glacial valley is beautifully clear on the north bank. The Lower North Branch enters with rocky falls, also evidently post-Glacial, and the original survey map by Berton has on this branch this legend, "very rocky and broken for three miles up." At the twenty-five and one-half mile bend, however, a broad, low valley extends northwestward, and no doubt represents the pre-Glacial mouth and lower course of the Lower North Branch.

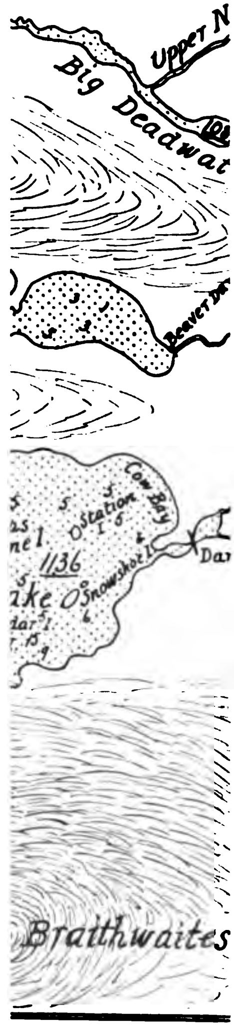
The scenery at the mouth of the Lower North Branch is altogether charming, as indeed it is at many points along this remarkable river.

For a mile below the Lower North Branch the river is drift-bottomed, open, and of ancient aspect; but at the twenty-five and one-half mile bend it narrows somewhat, here passing, according to our geological maps, from the pre-Cambrian to the Cambro-Silurian formation. Below twenty-six miles, begins another short series of falls over rocky ledges, extending to twenty-seven miles. These are also typically post-Glacial, and both ends of the pre-Glacial valley are clearly visible on the North Bank. This is the lowest series of bad rapids on the river.

Below twenty-seven miles, and down to Devil's Brook, the river runs swiftly with continuous drop, but with no falls nor bad rapids. Throughout all this part, however, the valley is very narrow and the walls steep, at times forming almost true cliffs. The edge between the valley and the peneplain into which it has cut is very sharp and level, and apparently somewhat under 200 feet above the bed. This part of the river in places recalls that part of the Nepisiguit between Nine Mile Brook and the Narrows, although on the geological map it is given as of a different formation. Despite its narrowness, however, it is probably a part of the ancient valley, for its bed is drift-filled. Probably its narrowness and the steepness of the banks is a characteristic determined by the hardness of the rocks.

From Devils Brook to Catamaran Brook the valley is more open, the peneplain lower, the river bed broader and drift-filled, and terraces appear, of a height estimated from thirty to forty feet. Higher up the river low terraces of coarse materials had been seen at the mouth of the Lower North Branch, and at twenty-six miles. Below Catamaran Brook the river bed becomes yet broader and more shallow, the walls of the valley farther back and the peneplain yet lower, and terraces become more frequent and higher, and of finer materials. At Otter Brook the first settlement is met with, and soon after the river breaks up among many islands and flows through a broad, well-matured and charming valley until it reaches the head of tide, a mile or two above the junction with the Northwest Miramichi.

In summary, the chief characteristic of the Little Southwest Miramichi River, from the physiographic point of view, consists in the many changes in its course due to the Glacial period. In this respect no other of our rivers, excepting the lower twenty-two miles of the Nepisiguit, can compare with it. As to why this river in particular shows this character in so marked a degree, I can only suggest that there may be some connection between this fact and the position of the river on the southeast, and therefore in the lee, of the Glacial movement over the highest land in New Brunswick. The leward position would be that in which glacial debris would most accumulate, and glacial debris is the indirect cause of the roughness of this river.



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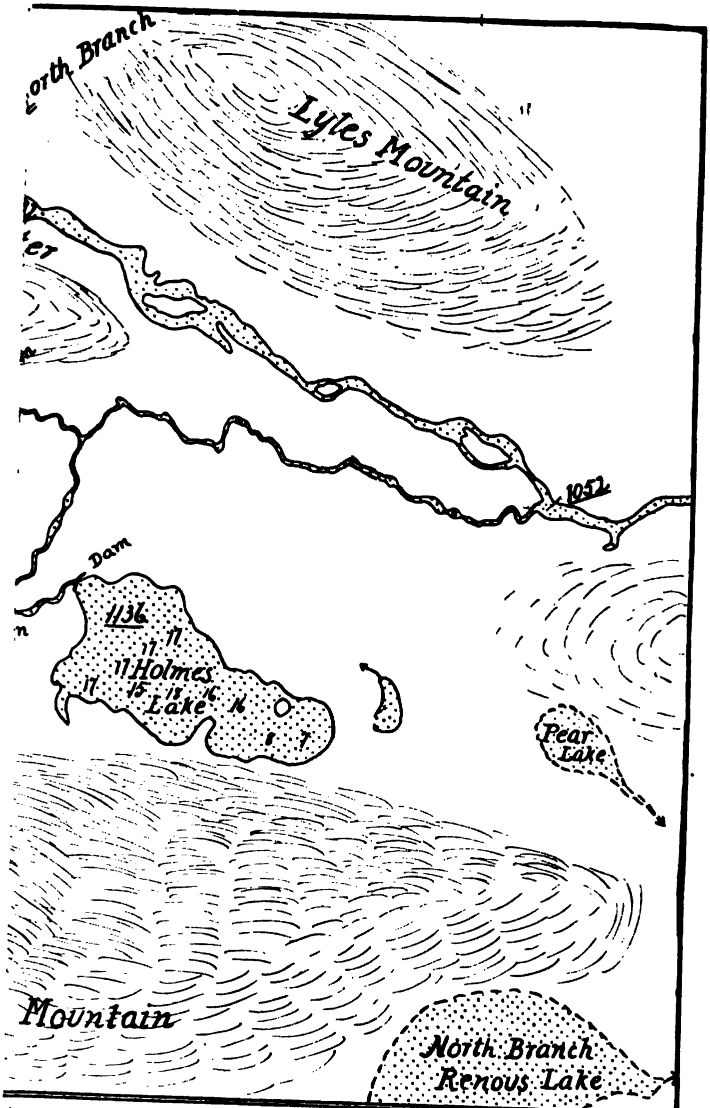

t Miramichi) Lakes
ONG & M.I. FURBISH
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d Pear Lakes
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Figures underlined are heights above mean sea level: other figures are depths in feet.

W.F.G. del.

55.— On the Physiography of the Tuadook (Little Southwest Miramichi) Lake Region.

(Read December 3, 1901.)

Near the head of the West Branch of the Little Southwest Miramichi River lies a group of attractive lakes, still in a state of well-nigh primeval wilderness, extremely difficult of access, hitherto unsurveyed and unstudied by the physiographer. In August last I spent eight days there in company with Mr. Furbish, and, favored by good weather, we surveyed them and made such other observations as follow.

History.—The first appearance of these lakes in any record is upon the remarkable Franquelin-DeMeulles map of 1686, where, though but a single lake is shown, it is unquestionably the Big Lake of this group.* They do not re-appear until they were visited by Hind in 1864.† In his well-known report,‡ he gives an account of his portage from Long Lake to Big Lake, which he briefly describes. He made no map, however, and the first map after that of Franquelin was made by Edward Jack, who visited the lakes in connection with explorations of timber-lands in 1873. Jack's map was, however, not based upon a survey, but was a simple sketch, and it formed the foundation of the first published map of the lakes, that on the "Map of the Principal Timber Lands of New Brunswick," 1875. A short note by Mr. Jack upon the geology and mineralogy of the region was published in the report of the Geological Survey for 1870–71, page 251. The lakes and river were visited by Ells in 1879 or 1880, though the references to the lakes in his report are very scanty.§ Aside from the very hasty visits of Hind and of Ells, no geologist had been in this section. In 1884 Mr. R. H. Lyle, a deputy surveyor, ran certain timber lines through the region, two or three of which crossed these lakes. From these lines the lakes were sketched by Lyle, forming the

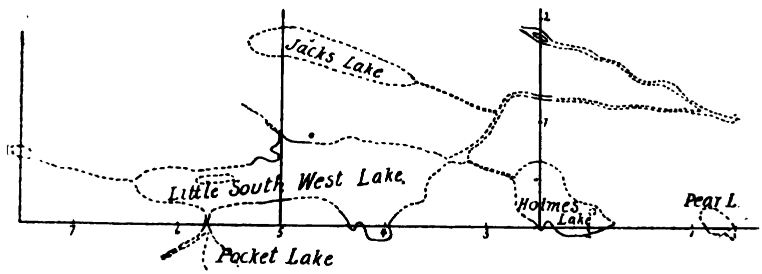
* This map is mentioned in earlier notes, 29 and 39; it is reproduced for the first time from the original MSS. in Trans. Royal Society of Canada, new series, III, section ii, 364.

† They should have re-appeared in 1838, for in March of that year Deputy Surveyor Berton was sent to survey the Little Southwest from its head. He missed the West Branch altogether, and began his survey at the head of the Big Deadwater, at the point marked on the accompanying map. This explains the appearance of the river and absence of the lakes on Wilkinson's map of 1859, and others.

‡ Preliminary Report on the Geology of New Brunswick, Fredericton, 1865, 152.

§ Report of the Geological Survey, 1879–80, D.

map shown in the accompanying cut (Map No. 4), and this sketch has formed the original for all published maps of the lakes, from Loggie's of that year down to the present. The Geological Survey map has, however, certain additions at the western end, of which I do not know the origin, and which are incorrect. In 1890 Mr. W. J. Long and Dr. Philip Cox ascended the river with Indian guides and spent several weeks upon the Big Lake, and it was there that Mr. Long made many of the observations upon animal life, which he describes with matchless charm in his well-known books.* Dr. Cox, however, has published no account of his observations. Both of these gentlemen made sketch-maps of the Big Lake, of which they gave us copies, and from which we have adopted many of the names upon our own accompanying map. More recently this region has been visited



MAP NO. 4.

repeatedly by another charming writer, Mr. Frederic Irland, who, in his beautifully-illustrated articles in "Scribner's Magazine,"† has given delightful, even if somewhat exuberant, accounts of his trips, though he has not many references to these lakes in particular. The late Frank Risteen has also described in his pleasing style a trip to this region.‡

These include all of the published references to these lakes which I have been able to find, and I believe I have missed nothing of importance. As to unwritten history, two points should be mentioned. The lakes were first lumbered about 1866 (for pine only), were later

* Wilderness Ways; Ways of Wood Folk; Secrets of the Woods (Ginn & Co., Boston); recently re-published under the titles, Beasts of the Field; Fowls of the Air.

† Sport in an Untouched American Wilderness, Vol. xx, 350; The Coming of the Snow, Vol. xxvii, 87; The Beguiling of the Bears, Vol. xxx, 313. See, also, Forest and Stream, Feb. 1, 8, 15. 1902.

‡ Forest and Stream, Dec. 22, 1894, 530.

abandoned, and within the past five years lumber operations have again been commenced, and are now being actively carried on at the Crooked Deadwater. About 1866 a lumber road, still called the old MacDougal pine road, was cut from Big Lake to Milnagek, and thence to Trowsers Lake for hauling out pine timber, but it has now almost entirely vanished. A winter portage road connects the Big Lake with Boiestown, over forty miles away. Again, this entire region is notable as the hunting and trapping ground of that prince of hunters, Mr. Henry Braithwaite, who knows it intimately, and who takes to it a number of sportsmen each autumn. It is a pity that Mr. Braithwaite's knowledge of its topography and natural history cannot, through publication, be made available to others and safe from loss.

PLACE-NOMENCLATURE.—There is no name in use for the group, as a whole, and, therefore, I have revived the Indian name for the Little Southwest Miramichi River, namely, *Tu-a-dook*, universally used by the Micmac Indians, but of unknown meaning. *Jacks Lake* was given by Mr. R. H. Lyle during his survey of 1884, as he tells me in a letter, in honor of the late Edward Jack, of the Crown Land office. *Holmes Lake* appears to have been named by Mr. Lyle for a lumberman. *Irland Pond* was named by Mr. Braithwaite, as he has told me, for Mr. Frederic Irland above mentioned, who shot here his first moose. *Big Lake* and *Pocket Lake* are descriptive, and self-explanatory, and probably originated with the lumbermen. The names of the Islands are mostly adopted from those given by Long and Cox in 1891, as shown on their sketch maps. *Longs* and *Coxs* are for themselves; *Tanaas* and *Hares* for their guides, while the others are descriptive and self-explanatory. *Station* (of our survey), *Beaver*, *Birch* and *Big Deadwater* have been given by us, and are descriptive. South of the lake is a fine mountain which has no recognized name, and we propose that it be called henceforth *Braithwaites Mountain*, in honor of Mr. Henry Braithwaite above mentioned. Another rounded mountain is named *Risteens Mountain* for the late Frank Risteen, well-known to all lovers of the New Brunswick woods, who has hunted in this region, while *Lyles Mountain* is for R. H. Lyle who surveyed the region in 1884, and *Bertons Ridge* is for Deputy Surveyor Berton who surveyed the Little Southwest Miramichi River in 1838.

ALTITUDES.—The heights of the lakes above sea level have been discussed in a preceding note (No. 53), and are recorded upon the accom-

panying map* (Map No. 5). Big Lake is made by us 1,136 feet above the sea. The only previous measurement was by Ells, who says :† "The general elevation of the lake at the head of the Little Southwest Miramichi is, by aneroid, about, 1,200 feet above sea level," an estimate which our measurements make somewhat too high.

GEOLOGY.—On this I have nothing to add to what is given by Hind, Jack and Ells in the notes earlier mentioned, and incorporated on the geological map. The whole country is covered with granitic and schistose boulders, the former in great majority, but Jack is not correct in stating that from Devils Book to Gulquac and Serpentine no rock in place is to be seen, for Hind records schistose ledges below the outlet of Big Lake, and I found some fine, large ledges of schist south of the old MacDougal road, over a mile west of the Big Lake on the line of a recent timber line, and ledges occur also on Milnagek Lake, as will be shown in a later note.

NATURAL HISTORY.—On this subject no publications exist aside from the notes by Long already mentioned. Doubtless, few animals or plants occur here that are not found elsewhere in the province. For studies upon the habits of the larger animals, the region is, however, unsurpassed. Beaver are now building their houses in Big Lake; moose and caribou wander in abundance and tamely around its shores, and other animal life is there in great display.

ECONOMICS.—The region abounds in fine spruce timber, the principal game and fur-bearing animals, and big trout. It is, on the other hand, utterly useless for agriculture and settlement. It is, therefore, a part of that central wilderness of New Brunswick, marked out by nature for a great timber and game preserve, and needing only good management to make it a perpetual source of revenue to the province, and an enduring natural recreation ground for her citizens.

THE LAKES INDIVIDUALLY.—This region, as a whole, has the features characteristic of so much of the interior of New Brunswick. Its shallow lakes, with margins and islands of boulders and bog, are connected by swift boulder-strewn streams, and lie amongst low domed hills and ridges clothed with unbroken forest.

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* All of this map, except the Big Deadwater, taken from Berton's plan, and the Pear and Renous Lakes, taken from the Crown Land office plants, is based upon our own plane-table and traverse surveys.

† Report of the Geological Survey, 1879-80, D. 32.

The Tuadook lakes by no means lie, as our printed maps imply, at the head of this branch of the Little Southwest. Flowing into Big Lake is a large stream of constant volume, large enough to be navigable for canoes at low water were it not for its excessive roughness. This flows from the Crooked Deadwater five miles to the westward, where it receives several branches of considerable size heading in lakes. I hope later to present a fair map of this region, but my own observation of it in a single hurried visit was insufficient to give me any knowledge of it. It lies some 175 feet above Big Lake in the same deep valley, which here has cut down deeply below the great central peneplain. The curious directions and the close approximation of the streams about the Crooked Deadwater suggest some remarkable physiographic relationships for investigation by the future student. A mile above Big Lake this stream becomes a deadwater winding amid bog, and is on the same level with Pocket Lake. Evidently Pocket Lake and this deadwater are the remnants of a much larger lake which once filled this basin. Pocket Lake is mostly but a foot or two deep, with a bottom of the whitish mud, though it is deeper in its southeast corner. The stream from it to Big Lake falls several feet over boulders, evidently a moraine between the two lakes. The water pouring out of this stream is markedly colder than that of the Big Lake, which is easily explained by the great shallowness of the latter.

Big Lake is sufficiently described as to its shape and size by the accompanying map (Map No. 5). Its immediate shores are nearly everywhere low, it is very shallow and is rapidly filling up with organic mud and by the growth of bog in places from its shores. Like Pocket and Jacks Lakes, it is deepest on its south-eastern side. It is permanently held nearly two feet above its natural level by the lumber dam built a few years ago, and the further raising of the water when the gates are closed has destroyed all the trees around its margin, making the shores most unsightly. The lake abounds in islands of all sizes, from single isolated boulders up to one nearly half a mile in length, but in every case they are composed of boulders, to which, in some cases, is added considerable bog. It is the presence of this bog which appears to make the long axes of the larger islands lie at right angles to those of the smaller. In fact, however, the long axes of the rocky parts of all of the islands is in the same general direction, namely, north-east and south-west, showing that they are really parts

of terminal moraines. Some of the points of the main shore are also rocky islands connected with the shore by bog. The greater abundance of islands and the greater shallowness of the water on the north-western side of the lake, and the greater depths of all of these lakes at their south-eastern angles, is no doubt correlated with the general south-easterly movement of the glacial ice, and is to be explained by the tendency of the drift to accumulate in the immediate lee of the bounding ridges or walls of the old valley. This entire lake is very typical of the sort formed by the partial filling rather than the damming of a valley by drift. Immediately to the southward of this lake rises Braithwaites Mountain, a fine mountain of some 500 to 600 feet above the lake. Off to the westward the edge of the great central peneplain can be seen resembling a flat-topped ridge, and to the north-eastward runs the ridge of Lyles Mountain, while, from some points, other hills are to be seen in the distance, including Cow Mountain, Big Bald, and others. These hill views give a considerable charm to the scenery of the lake.

Jacks Lake, separated by a low ridge from Big Lake, is very shallow, and a typical mud lake, having almost no water, but much new bog at its upper end, where it is rapidly filling up. It is quite possible that the stream now emptying near its head into Big Lake was in pre-glacial times an inlet to it.

The lake is held permanently some fifteen inches above its natural level by an old beaver dam. The organic mud must, therefore, have formed in the lake to the depth of over a foot since this dam was built; and since its sticks are still undecayed, we have evidence that the formation of this mud can be comparatively rapid. On the north-east this lake is bounded by an abrupt ridge (Berton's Ridge) some three hundred feet high which separates it from the Big Deadwater.

Holmes Lake is very pretty, the deepest of the group, and is not a mud lake. I do not understand at all the conditions which determine the formation of this organic mud* in some lakes and its absence from others apparently as favorable. Pocket and Jacks Lakes contain it abundantly, while Holmes does not, although the physical conditions appear to be about the same in both cases. Between Holmes and

* The nature of this mud in our lakes is discussed in an earlier note [No. 17, Bulletin No 17, 126]. Its presence does not appear to depend, as might be supposed, upon the absence of lime from the water.

Big Lakes there is only a few feet of elevation obviously composed of boulders, while just to the east of Holmes, is another small lake, and east of that comes Pear Lake emptying into Renous, all with insignificant elevations, apparently solely of drift, between.

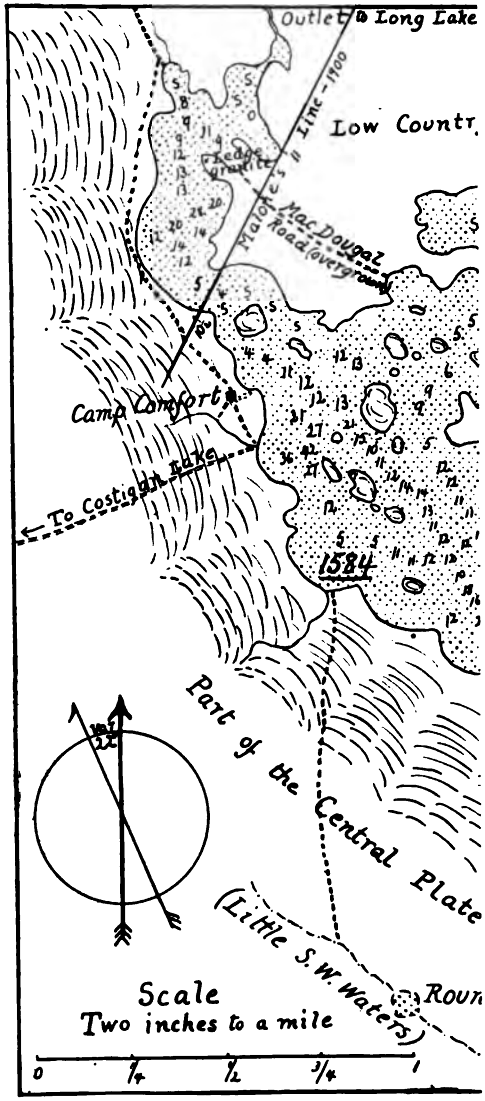
The outlet from Big Lake is a very rough stream flowing over trains of immense boulders (and according to Hind, over schistose ledges), with occasional quiet pools to the junction with the outlet of Jacks Lake, below which it continues, though with more frequent pools, but with many bad boulder rips, to the junction with the main stream. Just above the junction it breaks up among islands, and enters the main stream by two or three inconspicuous mouths, even the principal one of which is so small that it resembles a small brook. It is, no doubt, for this reason that Berton missed it in 1838, as would anyone unaccompanied by guides acquainted with this peculiarity. This part of the river is so narrow and shut in by woods that views of the hills are impossible, though the actual banks are everywhere low. It appears to me to be a new valley made across great beds of glacial drift, and prevented from cutting deeper by the great size and hardness of the boulders of which that drift is largely composed.

PHYSIOGRAPHIC ORIGIN.—We turn now to the very interesting question as to the mode of origin of these lakes. First, as to the origin of the valleys in which they lie. It is plain that the Big Deadwater, Jacks Lake, Big Lake and Renous valleys, all approximately parallel, have been cut deeply (at least more than 500 to 600 feet) into the surface of an ancient peneplain, which still exists in great perfection immediately to the westward of them, and of which facets are found in Braithwaites Mountain, and in the range running eastward from Lyles Mountain. The lesser elevations between the other valleys are due, of course, in part to the greater proximity of those valleys to one another, leading to the interference of their rims and the more rapid erosion of the intervening ridges. Their general northwest and southeast direction was, no doubt, determined by the slope of the peneplain at the beginning of the present cycle of elevation and erosion. The valley from the Crooked Deadwater to the Big Lake has a different direction, but its consideration must await further knowledge.

We consider next the recent changes due to the Glacial period. The most striking fact about the lakes, from this point of view, is the perfection with which Big Lake, Holmes Lake, the little lake east of it, and Pear Lake, separated only by low banks of boulders, lie in a line with one another, and with the branch of the Renous emptying Pear Lake. Taking into account, also, the parallelism of valleys in this region, and their general directions, it seems to me clear that these lakes belong, morphologically and originally, with the Renous system, and that their connection with the Little Southwest is very recent, if not post-glacial. This is further confirmed by the character of the stream from Big Lake to the main river, which falls continuously over glacial boulders, and, according to Hind, at first over ledges. The somewhat more riotous course of the stream from the Big Lake to the outlet of Jacks Lake, and the direction taken below this by the river, might suggest that the Big Lake had been turned into an older valley occupied by Jacks Lake, but it probably means that the stream here keeps near the same ridge which bounds Jacks Lake on the northeast. I believe, therefore, that in pre-glacial times all these valleys from Jacks southward emptied into the Renous; that the valleys were filled with glacial drift which dammed up the old Renous outlet, reversed the direction of flow of Holmes Lake, and sent the waters to find their way out of the valley by the lowest point, which happened to be a low place existing in the range formerly separating Little Southwest from Renous waters. This is further confirmed by the great contrast between the valley of the stream from the Big Lake and the old broad ripe valley of the main stream into which in falls, a point emphasized in the preceding note.

56.—On the Physiography of the Milnagek (Island) Lake Basin.

In an earlier note (No. 39), reference was made to the interest attaching to Milnagek, or Island Lake, as shown by the visit made to it in July, 1900, by Dr. G. U. Hay, Mr. M. I. Furbish, and myself. In August, 1901, Mr. Furbish and I spent eight days upon the lake and in its vicinity, and made further observations, together with surveys whose results are embodied in the accompanying map (Map No. 6).



Outlet to Long Lake
Low Countr
Ledge granite
MacDougal Road (overgrown)
Camp Comfort
To Costigan Lake
1584
Part of the Central Plate
(Little S.W. Waters)
Roun
Scale
Two inches to a mile
0 1/4 1/2 3/4 1

The first known reference to the lake occurs in Hind's Report on the Geology of New Brunswick (Fredericton, 1865, 152), where its position and size, as reported by the Indians, are mentioned. It first appears upon a map, but very erroneously, upon the Geological Survey sheet of this region of about 1888, where it seems to be laid down from Hind's description. The first map of it made from observation is that contained on our map of the Negoot Lakes accompanying the above-mentioned note, on which, however, it is shown too far to the westward. After our visit in 1900, a surveyor running timber lines in this region for the New Brunswick Railway Company ran a line across it (see the map), and made a crude sketch of the lake, which is in the Company's office at Fredericton.* Two or three scattered references to the lake occur in sportsmen's notes in "Forest and Stream." These, with my own reference in Note 39 of this series, seem to include the entire documentary history of the basin down to the present time. It has never before been visited by any naturalist, and, as implied above, has never been mapped. As to its unwritten history, there appears to be very little. Some thirty-five years ago some of the excellent pine was hauled from this lake into Trowsers by the "MacDougal pine road," but it has otherwise never been lumbered. A few sportsmen have visited it, guided by Messrs. Alexander and David Ogilvy, who know this region thoroughly, and who have a small hunting camp on the shore of the lake (Camp Comfort on the map).

The name Milnagek (*g* hard and accent on last syllable), is Maliseet Indian, and signifies, very appropriately, lake with many islands. It is the same word as Milnocket, occurring several times in Maine. The other names upon the accompanying map have been given mostly by the Ogilvys, either descriptively or, in the case of the proper names for sportsmen who have been taken there by them.

A chief point of interest about Milnagek is that it appears to be the most elevated lake of any importance in New Brunswick. Our single measurement of 1900 gave it as 1,510 feet; but the average of our seventeen good measurements (see Note 53) gave it as 1,584 feet, which, I believe, is very nearly correct. Squaw Lake, to the eastward, and lying very nearly on the top of the plateau, is 175 feet higher, and hence 1,659 feet, but it is little more than a shallow pond. The other lakes, Reeds and Cabots, are not much higher than Milnagek.

* I am indebted for a sketch of it, and of the Company's map of the region, to Mr. W. T. Whitehead, the Company's agent at Fredericton.

The scenery of Milnagek is beautiful. On the east, south and west the hills rise 200 to 300 feet near the lake, and are densely wooded with a fine, mixed forest, above which towers often the stately pine. The lake is studded with islands, all heavily forested, and between them and into the coves are many most charming vistas. The immediate shores are the more pleasing in that the forest comes to the very water, and the unsightly bog is wanting.

The physiographic origin of the lake basin is quite plain. The apparent ridges, nearly surrounding it, are really the sides of a valley cut from 200 to 300 feet below a great rolling plateau, a part of that great central peneplain of the province which has been described in an earlier note (No. 49.)* Southward towards its head the valley rises, and Cabots Lake, the very head of this branch of Tobique, lies about 150 to 200 feet below the plateau beyond it. Squaw Lake, on the other hand, lies upon the very surface of the plateau in one of its less elevated parts, and is one of the innumerable small and very shallow lakes which dot the surface of that peneplain. The valley where Milnagek lies was no doubt once much deeper, for it is evidently bottomed with glacial drift, which forms the most of the points and all of the islands. It is such drift which plainly dams back the lake, though the dam which does it is only a few feet above the water; that is sufficient, however, to turn the outlet from its natural and pre-Glacial course into the eastern branch of Trowsers Lake, and send it by a post-Glacial torrent-channel into Long Lake over a series of beautiful cascades. My supposition of last year (Note 39), that the Milnagek valley is morphologically the continuation of that of the eastern branch (the "left-hand leg" of the lumbermen) is fully confirmed by the observation of this year. After the outlet turns into Long Lake, this valley slopes away rapidly to Trowsers Lake, and indeed is occupied by a small stream for most of its length.

The islands and points of Milnagek are composed of granite boulders, somewhat angular, as a rule, and hence from no great distance. The long axis of both points and islands, as the map shows, is nearly northwest and southeast, suggesting an origin as lateral moraines of a glacier pushing up the valley. In two places shown upon the map there appears to be bed granite in place; in the most easterly locality it encloses masses of stratified rock, confirming the

* Rumsey's Hill is a fine example of a monadnock rising 150 to 200 feet above it.

intrusive origin assigned to this granite by the geologists of the province.

The lake is very irregular in depth, as is to be expected from its mode of origin, with a maximum of forty-two feet. The places of greatest depth mark clearly enough the course of the original channel or valley, which evidently lay near to the western side.

A very remarkable feature of this basin is the way its inlets interlock with those of the Little Southwest Miramichi system, as is shown by the map. This interlocking takes place upon the surface of the plateau, and shows how nearly level the latter is. It is most remarkable of all, however, at the Squaw Barren. This is an opened bog of the raised or "Hochmoor" type. On the west it drains into Squaw Lake, an affluent of Tobique, and on the southeast into Rumsey Lake, a beaver pond draining into the Little Southwest Miramichi. It cannot often be that such a bog forms the watershed between two systems so important.

These lakes abound in moose, caribou, deer and smaller game, with some beaver and abundant trout. Gulls nest on the islands, but otherwise we noted nothing remarkable in the natural history of these lakes.

Finally we consider the economics of the region. It contains some pine and spruce of value which will of course in time be removed, and its big game will make it increasingly attractive to sportsmen. It is of no value for agriculture, and its chief use is marked out by nature, as a part of that great forest and game reserve for which central New Brunswick is so admirably fitted. There is, however, another use for it suggested by its elevation and general attractiveness, namely, as a sanitarium for lung troubles, for which it should be better adapted than any place I have met with in New Brunswick. At present it is very difficult of access, but this will not always be the case.

ARTICLE III.

THE SOUTH TOBIQUE LAKES.

By G. U. Hay, D. Sc.

Before the end of the twentieth century there will probably be few unexplored regions in this province, or lakes where the tell-tale dotted line marks them as unsurveyed, or lakes that have no existence on our maps. But that is the case now. There are some eighteen lakes — large and small — that form the sources of the rivers and streams that enter the Tobique river from the south side. A third of these are either not marked at all or are imperfectly outlined on the maps of New Brunswick in common use. These lie close to the watershed that separates the sources of the Tobique and Miramichi water systems.

In this region Prof. Ganong and I spent nearly four weeks during the summer of 1900, going in to Trowsers Lake from the Tobique river over a portage road twenty miles long, camping nearly a week at the upper extremity of that lake, whence we made short daily excursions to the lakes and streams adjacent. From Trowsers Lake we made a portage to Long Lake, the largest of the system. Here there is also within easy reach of either extremity a number of small lakes. From Long Lake we visited in succession, "carrying" over intervening portages, Portage, Adder and Serpentine Lakes. The outlet of the last named lake is Serpentine River, which, after a swift run of thirty miles, brought us to the Forks of the Tobique, nearly thirty miles above the point where we started in. While Prof. Ganong attended to the physiographic features of the country and took measurements, I examined and collected plants, and took views by means of a camera.

The country traversed is a wilderness, the low lying portions of which are thickly wooded with spruces, firs and other evergreens, giving a somewhat sombre aspect to the country. The ridges are clothed with a more diversified growth of deciduous and evergreen trees. All the smaller lakes are shallow, and the low-lying shores

adjacent are the resorts of moose, deer, caribou, beaver, and many of the small fur-bearing animals. Trout abound in great numbers in the streams and thoroughfares adjacent to the lakes, while the togue or namaycush, a fine species of lake trout, is found in at least one lake of the series — Long Lake.

Owing to the remoteness of this district, the difficulties of transportation, and the fact that the waters do not contain salmon, the lakes are seldom visited by fishermen. But in the fall of the year they are a great resort for moose and deer hunters, and in winter trappers visit the region. The "deadfalls" and other cunningly devised traps met with in every direction during the summer show the elaborate plans made for the capture of the small but valuable fur-bearing animals. The distance from the main waterways of the province is also an obstacle to lumber operations, but in proportion as lumber has become scarce in the more easily reached areas, this region has been penetrated to quite a considerable extent by lumbermen who have erected dams at the outlet of Trowsers, Serpentine, and some of the smaller lakes to hoard up an adequate supply of water for artificial freshets in the small streams that flow from these lakes. As a result, the water has risen five or six feet in the lakes, drowning the plants and roots of trees along the shores, which now present a desolate appearance from the dead trunks leaning out over the waters.

Our two day's journey over that portage road which brought us to Trowsers Lake gave plenty of opportunity to study the general features of the country and the plants by the wayside. The road, for the first three or four miles after leaving the Tobique river, led through bogs and low grounds with the vegetation usually found in such situations. The Labrador Tea (Ledum latifolium) exists in profusion ; and should our tea-drinkers ever turn to the brewing of the home product there will be an abundant supply in this South Tobique Lake region. Viburnums, red and black spruces, Rhodora, Vacciniums, Kalmias, Andromeda and other heath plants were found. Then, as the country became more broken and we wound through valleys and over hills, the vegetation became entirely changed. Along the courses of streams the osmundas and ostrich ferns lifted their luxurious fronds, purple trilliums and violets, blue and white, reminded us that this northern country was still in the midst of its spring season. As we neared Trowsers Lake magnificent forests, some of them such as I had never

seen before, crowned the sides and summits of the ridges. Gray, yellow and white birches, rock maples, beech, spruce, with occasionally some giant white pines told of generous conditions for growth. The white birch and red spruce were especially noteworthy. The white birch in all its luxuriance I had never seen until I saw it on these hillsides. Some well-rounded and symmetrical boles, fully two feet in diameter, rose tapering to the height of sixty or seventy feet, the white bark contrasting with the vivid green of its wealth of foliage. It deserves its title of "The Lady of the Woods." And here were lordly spruces that guarded the gateway to what might be well termed the "Country of the Spruces" that we were now entering. They rose from seventy to ninety feet in height, straight as an arrow, long, slender cone-shaped trees like church spires that were suggestive of some sylvan city of churches—and who would not be a worshipper in a city like that?

When our guides left us at the lower end of Trowsers Lake on the morning of the 5th July, we devoted ourselves to the consideration of how our 300 pounds weight of baggage and stores could be put away with sufficient compactness and safety in our little basswood canoe of sixty pounds weight. This accomplished, we paddled up the left "leg" of the lake, before a stiff north-west breeze, to the site of our first permanent camping ground, five miles away. Here we remained several days exploring the lakes and forests in the vicinity.

The next morning we started out through a woodland portage path to the next lake, about a mile and a half distant, carrying our canoe, Indian fashion, on our shoulders, resting at times and enjoying the rare beauty that met the eye at every step. It was an ordinary well-beaten path, trodden, perhaps, for centuries past by the feet of Indian hunters, guides, trappers, and perhaps by mere adventurers like ourselves. The vegetation was typical of nearly all our northern forests, but the different layers of vegetation had never appeared so distinct and well arranged as along this particular woodland path. Lowest down was a carpet of moss, chiefly hypnums, amid the dead leaves of previous summers. Struggling through this and forming the second layer were those plants that delight the wayfarer in nearly all our woodland groves, the Wood Oxalis not yet in bloom, the slender Linnæa, "with its twin-born heads" and delicate fragrance, the Solomon's Seal (Smilacina), occasional patches of blue violets, the Clintonia, the Gold-

thread (Coptis trifolia), the Star of Bethlehem (Trientalis Americana), with occasional clumps of ferns and lycopodiums. Forming the third layer were the shrubs and young growths of trees, viburnums, maples, the Canadian Holly, etc.; while towering above all these were the trees — spruces, firs, white, yellow and grey birches, maples and others.

The end of our portage path brought us to Milpagos Lake, which means the lake of many coves. It is about two and one-half miles long, very irregular, as its name signifies. A red deer on a little interval fifty yards away gazed on us with wondering eyes for a moment and then disappeared into the woods. We paddled along the shore of this lake for about half a mile until we found a path leading to Gulquac Lake. This, like the lake we had just left, has low-lying and boggy shores. Both lakes are muddy and shallow, the shallower parts sending up a growth of rushes, yellow and white pond lilies, while among innumerable small plants along the shores the Droseras are spreading their leaves to catch unwary flies. Here we came face to face with our first moose. The wind was blowing toward us, and he did not see us, so we had a fine opportunity to examine him at our leisure, and a noble-looking animal he was. We watched him browsing, and not until the camp-fire was lighted for our mid-day lunch did he take the alarm. He saw the trail of smoke as it curled up over the trees and vanished. It is thus with all wild animals; the moment they see the smoke, or when the smell of fire reaches their delicate sense of smell, they flee in terror.

Gulquac Lake is a beautiful sheet of water, even though its shores are boggy and low in most places. To the north-west rise two mountains of equal height—about six hundred feet high, and these are in view from every part of the lake. It is about a mile and a half long, and, like Milpagos Lake, it has numerous little bays, with islands near each end, and a fine sheet of water between. Near its west end, where it flows out into the Gulquac river, we came upon a beaver dam, constructed across the narrow part of the lake, the difference of level between the water above and below being about eighteen inches. It was composed of sticks placed slanting in the water and made firm with mud and stones. The cutting of these sticks and small logs in the woods beyond, often a considerable distance away, the carrying and putting them in their places, and then firmly placing them together, anchored with rocks, and cementing the whole with mud and clay,

shows not only the wonderful skill and ingenuity, but most extraordinary industry on the part of this animal. Their houses, too, are built on the same substantial plan. They are found usually on the borders of the lake, at some distance behind the dam, the water stored by the latter means being necessary to secure free entrance and exit at all seasons of the year. The beaver house is a broadly conical structure, built strongly of small logs placed deep in the ground and slanting upwards, secured by stones, the interstices being filled with moss, twigs and clay, forming a fortress absolutely invulnerable to all predatory animals.

Our approach to this, our first beaver house, was slow and cautious, with the hope of obtaining a sight of one of these interesting animals, and we were not disappointed. Just as we rounded a point and the house came in view, we saw a beaver basking in the rays of the afternoon sun, or perhaps taking in the beauties of the purple pitcher plants which bordered the avenue of water that led up to the house.

On becoming aware of our approach, he greeted us with a grunt of displeasure, then dived and entered his castle through its only portal. There was a communication to those below in the same grunting tones, sounding more like regret than anger; then all was still. We lingered about the house for a time awaiting some sign of that hospitality due to strangers in a strange land. But no sound came, nor did we get sight of another beaver on that whole trip.

The beaver dam in Gulquac Lake was the largest and best constructed of any that we saw. But nearly everywhere on these shallow lakes and their adjacent streams dams were found, and houses, many of them unoccupied. The advent of the lumbermen, who build dams, often on the sites of the beaver dams, has driven them to more remote wilds. The illustration here shown is of an unoccupied beaver house, in a good state of preservation, at the lower end of Serpentine Lake. Beyond the house may be seen the lumbermen's dam built upon the sight of a former beaver dam.

On Saturday, July 7th, and the following Monday, we made excursions beyond our camping ground to the lakes and sources of the streams in the South Tobique Basin. As a description of these has already been given to this Society by Dr. Ganong in his "Physiography of the South Tobique Lake Basin," I shall merely give an account of some of the plants found: A few of the most common were Ledum latifolium, whose white blossoms mingled with the white tufts of the cotton grass (Eriophorum polystachyon) formed a striking contrast to the rose-colored blossoms of the Rhodora Canadensis and the two Kalmias (K. augustifolium and K. glauca), and the rich purple blossoms of the Pitcher Plant (Sarracenia purpurea).

The abundance and variety of blossom, mingled with the vivid green of the foliage in the foreground of these lakes, relieved the sombre character of the woods of black spruce and other evergreens which extended to the hillsides beyond. The black spruce, with its jagged, uneven tops, is everywhere in evidence here. There were very few tamaracks, few alders, except along the courses of the streams, a sprinkling of white birch of a small growth, numbers of Spiræa (especially S. salicifolia), Viburnums (Viburnum cassinoides, V. opulus, V. pauciflorum), Cornuses (C. stolonifera, C. alternifolia), Rowan tree (Pyrus Americana, with its smaller congener P. arbutifolia), wild cherry and bilberry (Prunus Pennsylvanicum and Amelanchier Canadensis.)

The lakes were filled with Yellow Pond Lilies (Nuphar advena, and N. kalmiana). The root stocks of these, especially the newer portions as well as the young shoots, serve as food for the moose and other wild animals. The moose may often be seen out in the lakes with head in the water digging them up out of the mud, and on these occasions when their eyes are blinded with the muddy water, and with

the wind in your favor, a very near approach to the animals can be made. The older and tougher portions of the root stocks of the yellow pond lilies cover the surface of the lakes sometimes, especially along the shore, to such an extent that it is difficult to make a landing from a canoe. Whether such a wholesale destruction is caused by moose and by beavers, which are also said to feed upon these, or whether it is caused by the ice in winter freezing down to them and raising them up with the mud in the spring freshets, we could not decide. Along with these the white, sweet-scented Pond Lily was growing, whose root stocks are also said to be relished by moose. Then there were Brasenia peltata, numerous potamogetons, Limnanthemum lacunosum, the horsetail, Equisetum limosum, very abundant, a grass whose bright steel blue leaves lay on the surface of the water—Glyceria borealis—which turns out to be a new plant to the province, many sedges, especially carices, with some half dozen species also new to the province. A fuller report of the new and rare plants is given in an appendix in Bulletin Number XIX.

The farthest point examined in these lakes, the waters of which find their way to Trowsers Lake, was a small lake in the form of a triangle, its vertex pointing to the south-east. Into this flowed a stream of ice-cold water from springs in the hills beyond, indicating the sources of the southwest branch of the Tobique. The lake was shallow, with low-lying grounds around, the shores covered with flat stones, and numerous moose and deer paths leading to the water's edge. In the meadow, bordering the stream that flowed into this lake, were found Iris versicolor, Osmunda regalis, O. claytonana, Onoclea struthiopteris, Ranunculus abortivus, R. septentrionalis, Calla palustris, with droseras and violets in profusion; and Hydrocotyle, Nasturtium palustre, several carices and the moss, Fontinalis antipyretica—all lovers of cold water.

The country about the sources of the South Tobique River has been untouched by forest fires. May it long remain so! Owing to its remoteness, it has not been lumbered to any great extent. Far as the eye can reach from the top of some lofty pinnacle, it is a great evergreen forest — the country of the spruces — the swamps and lake borders covered with the slender black spruce of the swamps, the higher grounds and ridges covered with red spruce, that valuable timber tree, intermingled with birches, maples, and a few pines.

This country, with other tracts at the headwaters of our great rivers, may be preserved for ages, and, by judicious management, it may yield every year a handsome revenue, and still steadily increase in value. New Brunswick's greatest source of wealth must be her forests. What has taken many generations of the past to come to perfection should not be despoiled by one generation. It should be the pride of our government and people, and a sign of their growing public spirit and scientific knowledge, sacredly to hand down that wealth that we have inherited to future citizens of the country.

The dangers threatening extinction to our forests are three: from forest fires; from selfish, illegal and unintelligent plans of lumbering; and from the cutting of young trees for pulp mills. The bare tracts of country in the southern parts of the province, and on the Nepisiguit, and some portions of the Miramichi, show how a country may be utterly devastated by ravages from fire, without hope of restoration to its former condition for many generations. The pictures of desolation from forest fires, which can be seen from so many hill-tops in the province, should show us how careful we should be to lessen this great danger to our forest wealth; and not only have forests been destroyed,— in many instances the land has been rendered incapable of production perhaps for centuries.

If our lumbermen select the largest and best trees for their operations, gathering the tops and branches, with some of the smaller growth in the denser portions, for the pulp-mill manufacturer, this region of the South Tobique and others through the province would increase in value each succeeding year. The great need in these forests is a judicious pruning of small trees, especially on the low grounds, in order to give an opportunity for the stronger and more shapely trees to grow; and the careful removal of branches and tops to lessen the danger from forest fires. Thus the waste products of the lumberman, which have been the source of so much damage in times past to our forests, and the stunted and misshapen growth of smaller trees in the denser woods, would not only be removed, but much of it made use of for manufacturing purposes. In Germany the forests, in spite of the large and profitable lumber "cut" each year, are constantly becoming more valuable. And this is the result of trained and intelligent supervision. And so it would be in New Brunswick if similar methods prevailed. Our game and fish wardens

should be trained in forestry. It would pay the government a hundred, yes a thousand-fold, to give our game commissioner added authority over forests, give him intelligent and trusted wardens, skilled not only in the knowledge and habits of game and fish, but also in forestry. It would take a little time to train such a body of experts, but the results would be great, placing New Brunswick in a position to preserve and add to what must prove the source of her greatest material wealth—her forests, her game, and her fisheries. At the same time she would place herself in line with those countries which, by wise and effective legislation, are laying a foundation for the preservation and future development of rich material resources.

We were encamped at the head of Trowsers Lake for five days. During the next ten days, amid almost continuous rains, with here and there a fine day, we journeyed eastward to the Serpentine river, passing over Long, Portage, Adder and Serpentine Lakes with several smaller lakes and ponds. Owing to the heavy rains the streams were swollen to freshet size, and the swamps and low grounds near them were difficult to cross. There was water everywhere. Of the portages, one was two and a half miles long (between Trowsers and Long Lakes); another was fully three miles, and very rough and uneven, but several small ponds intervened, which were easily crossed in canoes. The lakes, above named, are all very beautiful, especially Long Lake, a sheet of water bordered by high hills, six miles long and from one to two miles in breadth The soundings at one place in this lake showed a depth of 117 feet. A mile or two to the southwest of this lake is Milnagek, or the "Lake of Many Islands," no less than fourteen of which dot its surface. About six or seven miles to the southeast lies the lake which is the source of the Little Southwest Miramichi, the portage path to which, described by Professor Hind many years ago, Professor Ganong, aided by Mr. Furbish and guide, attempted to find, but in vain.*

The Serpentine Lake and River, both of which have remarkable windings, brought us into the Right Hand Branch of the Tobique river, and from that we came to the main Tobique to our place of starting. The Serpentine river is thirty miles long, and descends in

*During the summer of 1901 Professor Ganong and Mr. Furbish again visited this section, made a path for themselves across the country from Long Lake, and descended the Little Southwest Miramichi. See Professor Ganong's articles in this Bulletin.

that length 1,000 feet. The water was very high and the stream running like a race-horse. Our canoe shot over boulders and turned the many windings of the river with a speed that was exhilarating to the highest degree. I shall never never forget the joy of that first afternoon on the Serpentine, the delight of riding full speed on the back of a rapid torrent, racing past little islands covered with Osmundas (O. regalis and O. claytoniana), the tumultuous waters rioting among the fronds, whose dainty green contrasted with the darker shades of alder and viburnums on the banks. Virgin's Bower twined gracefully in festoons over shrubs, with Meadow Rue and Joe-Pye Weed bending their tall stems over the waters, while on the near hill-

sides beyond were the darker evergreens. It was difficult to take in the full beauty of the scene, as each turn of the river brought fresh pictures constantly into view. The delights of days like that, with a little spice of danger thrown in, linger in the memory for a lifetime. I have often since found myself careering in imagination over that wild and capricious little river, involuntarily ducking my head to escape an overhanging branch, or shying to avoid some dangerous boulder as we swept by; and then as we came into more quiet stretches of the river, resting on our paddles and taking in these scenes of wildness and beauty.

I can only briefly refer to two side trips that we made while descending the Tobique,—one to Sisson gorge, six miles from the forks of the Tobique, and the other to Bald Head mountain, a picture of

which is here given from a photograph taken from the plain near the base. The trip up the Sisson Branch, as far as the gorge, was accomplished with the greatest difficulty, owing to the high water, although the stream itself presents no obstructions. We were well repaid, however, for the extra exertion by a view of the gorge, one of the wildest and most picturesque spots in New Brunswick. There is a succession of five cataracts tumbling one after the other to a depth of one hundred feet, after which the stream flows in a series of rapids through a gorge walled by perpendicular rocks until it reaches the smoother stretches beyond. On the rocks overhanging the stream further down were found *Aspidium fragrans* and *Woodsia glabella*, two of the rarest ferns in the province.

The descent of the Sisson Branch and the main Tobique, as far as Riley Brook, a distance of twelve miles, was made in a little over an hour and a half in the midst of torrents of rain. On the following afternoon, Friday, July 27th, we paddled leisurely twenty miles further down in about three hours, which may show the swiftness of the current, the river being unusually high for this season.

On the morning of this day we visited Bald Head, a distance of five miles from the village of Riley Brook. This elevation, which is about 1,400 feet above the valley of the Tobique, is perhaps the most typical and regular mountain in New Brunswick, rising one thousand feet from the plain at its base, in the shape of cone, the upper portion covered with loose stones and boulders. On the top we found a narrow ridge which contained a great variety of plants, as follows, the trees being stunted and irregular: Pyrus Americana, Betula lenta, B. papyracea, B. pumila, Prunus Pennsylvanica, Acer rubrum, A. Pennsylvanicum, white and black spruces and firs, Nemopanthes fascicularis, Ledum latifolium, Sambucus pubens, Epilobium angustifolium, Cornus Canadensis, Vaccinium Canadense, V. Pennsylvanicum (narrow and wide leaved forms), Ribes lacustre, R. prostratum, Rubus strigosus, R. triflorus, Antennaria margaretacea, A. plantaginifolia, Galium triflorum, Kalmia angustifolium, Aralia nudicaulis, Trillium erythrocarpum, Aspidium spinulosum; besides several grasses and carices, two species of lycopodium; hypnums, polytrichums, and lichens covering the rocks and trunks of trees.

[For a list of the new and rare plants found during the trip, see Bulletin XIX, 1901.]

APPENDIX.

PRESIDENT'S ADDRESS.

By Hon. J. V. Ellis, D. C. L.

With considerable feeling of anxiety I have undertaken to prepare what our programme describes as the annual address of the president. If custom had made it imperative that I should review the incidents of our operations during the year, describe our meetings and criticize our proceedings in a judicial and friendly spirit, I would have considered myself fortunate; but on looking over the addresses delivered by gentlemen whom it is my good fortune to succeed here, I got no suggestion as to the form which the address of a mere layman might take. It has been the practice of almost all of the preceding presidents to consider some matter of interest along their own special lines of study and of knowledge, and from their fields of information and observation both interest and enlighten us. Unfortunately, I cannot take any excursion into the field of natural history in which I would care to be your guide, and you will see from this the difficulties of my position. Yet as I have turned over the numbers of our Bulletins for several years, I have had some reward. I have been able to appreciate more fully than ever before the amount of work which has been done by our more active members in their varied fields of labor, in their study of land animals, birds, fishes, insects, plants; in their close enquiry into our past and present geological conditions; and in the facts which they have acquired respecting the habits and customs and general life of the original occupants of this land, by means of which they have increased our interest in all forms of life in our province, and widened and enlarged the bounds of knowledge in many useful and attractive directions.

As near as may be, this meeting is our fortieth anniversary. The first steps in the formation of the Natural History Society of New Brunswick were taken at a meeting held in the Mechanics' Institute

on January 29, 1862, at which it was resolved to form a scientific association under the name which we now bear. Two specific declarations were made, viz.: that "one of the efforts of the society shall be to form a collection of books of a scientific character for the use of the members," and another, that it shall be a special aim to make "such a collection of specimens in the different branches of scientific research as shall fully illustrate the natural history of this province, and, as far as possible, that of other countries." That was our beginning, and the field of work laid out has been amply tilled and cultivated, and we have developed investigations whose fame has gone out far beyond the limits of our city and province, and of whose work as original discoverers we are justifiably proud.

The forty years that have elapsed have been years of marvellous progress in the scientific world. Of course it cannot be claimed that what has taken place in the forty years is the product alone of the period, for there are antecedent causes and the work was well under way with the commencement of the nineteenth century. But the practical application of science to utilitarian purposes has, in the words of Huxley, created a New Nature, begotten by science, and has worked miracles which have modified the whole fashion of our lives. Naturally and easily we may draw a mental distinction between those who investigate and endeavor to interpret the voices of nature, who pursue their work with untiring energy, and who are thrilled with joy as they extract from her some of her closely kept secrets; and those who merely make application of the knowledge thus acquired by others to the uses and needs of man. The first are nearer and dearer to us and we can share their joyous thrills at every discovery they make, not only for their own sake but because they make possible the labors of those who would apply *their* work to man's advantage.

The philosopher and student to whom I have just referred expressed the opinion that our epoch has produced three great things in physical science: one of these is that doctrine of the constitution of matter which is spoken of as molecular, the second is the doctrine of the conservation of energy, the third the doctrine of evolution.

No doubt Mr. Alfred Russell Wallace is correct in his assertion that in popular estimation and perhaps in real usefulness the establishment of the general theory of evolution, by means of the special theory of the development of the organic world, through the struggle for

existence and its but necessary outcome, Natural Evolution, is the great scientific work of the nineteenth century. And a philosopher and student of an entirely different kind, Mr. Leslie Stephen, declares that he has no doubt that the future historian of thought will regard the promulgation and the rapid triumph of evolutionist doctrines, as the most remarkable phenomenon in the intellectual development of the century. Although there had been hints at such a theory in the past, they had been merely hints and no definite statement had been made. The ordinary amount of scientific knowledge or information in evidence concerning the material world, did not seem to require any general theory of how species came into existence.

With great pains and great care scientific men had classified birds and animals and plants, and had pretty well settled upon the order and species to which they belonged, but the enquiring mind could not rest here fully satisfied that all was known that could be known. How did these species originate? If all matter could be reduced to simple atoms, by what law did matter operate, and upon what principle did it arrange itself in the various forms, simple and complex, living and dead, in which we find it? No doubt the earlier students of natural history, so far as the living, growing world was concerned, busied with their classifications and efforts at determinations, were generally satisfied that each species of animals and plants was a distinct creation, and this was sufficient for their purposes, but there were among them men who often wondered how these distinct creations were produced, and by what law they came into being. Those who had studied or were studying the physical world, the earth, the solar system, the stellar universe, had had their attention drawn to the origin of things, and here and there were suppositions, vague theories, ingenious speculations, but it will be found among those who investigate the subject, that at first naturalists were less inclined to look with favor upon the idea of evolution than were the mathematician and philosopher, who were engaged in working out a natural law for the whole universe. I can remember reading about 1850 the work "Vestiges of Creation," which was published six years before by an anonymous writer, who for the first time gathered up and placed in a very attractive manner, the ideas of those English and continental students who believed in a progressive development, due to an impulse imparted to the forms of life, by which impulse they were advanced

in definite lines by generation through grades of organization eventuating in the production of the highest plants and animals.

This work, after some years, was found to be the production of Mr. Robert Chambers, of the great publishing house of J. W. & R. Chambers, of Edinburgh. It was really the first publication in Europe in any orderly and popular way, of the theory of progressive development. Its tone was mild and serious. It went further, I think, than modern science will justify in respect of some statements which it made regarding the coming into existence of new creations of life, but it made no attempt to show how or why the various animals and plants have distinct characters, and how there came to be in the world all the existing variations. "Vestiges of Creation" was the first attempt to put into systematic shape, from the naturalist's point of view, the views of the evolutionists. In 1852 Herbert Spencer, who was not a naturalist so much as he was a logician, published his "Creation and Development" essays, in which, with all his logical force and consistency, he discussed the idea of development as against a special creation. Eight years later came Darwin's Origin of Species, an almost marvelous work, in which the whole subject was presented with a fulness and thoroughness which forced the question upon the honest consideration of thoughtful men; and thus the subject was before the world in all its strength! Of course it met with great opposition. It was believed to be a doctrine fatal to the received religious faith of Christendom, and even scientific men, liberal and broad-minded as Sir John Herschel, condemned it as heresy, while a no less eminent geologist, Mr. Lyell, declared in the earlier editions of his great work, that the known facts of geology were fatal to the theory of progressive development. Sir Charles must have receded from this position eventually, and, indeed, it is surprising that he ever held it; for his own view, which he so successfully established, that all the changes which had taken place in the earth's crust could be accounted for by conditions which now exist, and which are in operation in this age, was a declaration of a belief in a general and universal law governing the operations of nature; or, in other words, if natural causation is competent to account for the not living part of our globe, why should it not account for the living part? Although the literary and scientific world, as well as the religious world, regarded with disfavor the arguments and reasoning in support of the theory set forth by

Chambers and proved by Darwin; the theories advanced gained adherents, and, as fact after fact was brought to light, which sustained the idea, men gradually became reconciled to it. It may be of interest to observe that the theory of the survival of the fittest in the process of evolution was reached by two thinkers acting independently of each other. This theory is held to account for the variation and development which have taken place, and which are taking place in the origination and creation of species. Mr. Chambers declared that there was a principle of progressive development. He did not, as I have already stated, explain *how* or *why* there was such a law. Mr. Alfred R. Wallace and Charles Darwin thought out the subject. Mr. Wallace's statement of his share in the matter is an interesting paragraph in one of his latest books, page 140:

"While considering, he says, the problem of the origin of species, something led me to think of Malthus' Essay on population which I had read about ten years before, and the positive checks — war, famine, disease, accidents, etc.,—which he adduced as keeping all savage populations nearly stationary. It then occurred to me that these checks must also act upon animals, and keep down their numbers; and as they increase so much faster than man does, while their numbers are always very nearly if not quite stationary, it was clear that these checks in their case must be far more powerful, since a number equal to the whole increase must be cut off by them every year. While vaguely thinking how this would affect any species there suddenly flashed upon me the idea of the *survival of the fittest*—that the individuals removed by these checks must be on the whole inferior to those that survived. Then considering the variations continually occurring in every fresh generation of animals or plants, and the changes of climate, of food, of enemies always in progress, the whole method of specific modification became clear to me, and in the two hours of my fit I had thought out the main points of the theory. That same evening I sketched out the draft of a paper; in the two succeeding evenings I wrote it out and sent it by the next post to Mr. Darwin. I fully expected it would be as new to him as it was to myself, because he had informed me by letter that he was engaged on a work intended to show in what way species and varieties differ from each other, adding, my work will not fix or settle anything, I was therefore surprised to find that he had really arrived at the very

same theory as mine long before (in 1844), had worked it out in considerable detail, and had shown the MSS. to Sir Charles Lyell and to Sir Joseph Hooker; and on their recommendation my paper and sufficient extracts from his MSS, work were read at a meeting of the Linnæan society in July of the same year, when the theory of natural selection or survival of the fittest was first made known to the world. But it received little attention till Darwin's great and epoch-making book appeared at the end of the following year."

Enquiring as to the state of educated, literary and scientific opinion on the general subject at the present hour, Mr. Wallace says:

"Evolution is now universally accepted as a demonstrated principle, and not one single writer of the slightest eminence, that I am aware of, declares his disbelief in it. . . . . What was 'a great heresy' to Sir John Herschel in 1845, and the 'mystery of mysteries' down to the date of Darwin's book, is now the common knowledge of every clever school-boy, and of everyone who reads even the newspapers. The only thing discussed now is, not the fact of evolution— that is admitted — but merely whether or no the causes alleged by Darwin are themselves sufficient to explain evolution of species, or require to be supplemented by other causes, known or unknown. Probably so complete a change of educated opinion on a question of such vast difficulty and complexity was never before effected in so short a time."

One of the surprises which greets the ordinary mind in dealing with the Darwinian work is the extent of the variations which are possible and probable under the one general law. All that Darwin tells us of results obtained, of the effects of domestication, of cross-breeding in plants and animals, of knowledge which he derived from the motions of plants and from the lives of insects which lived among the vegetation that he observed, is delightful reading, and yet quite as much may we observe were our opened eyes at some flower show, where we see gorgeous masses of bloom, lovely developed and beautifully painted leaves, the very aristocracy of plant life, produced by the skill of the planter from some weed of humble origin.

Mr. Huxley raises the point—he almost vexes us by raising it— whether it may not be possible that while this existing universe is a universe of law and order, a universe of simplest matter and definitely operating energy, it is as well a product of evolution from some pre-

ceding universe in which the manifestations of energy were not definite, in which, in other words, law did not regularly prevail, in which there are, for example, some good units and some bad ones, and in which, possibly, like the boys and girls at school, the good are sometimes bad and the bad, at times, surprisingly good. It is sufficient for us now that we have a recognized law, and into its ancestry enquiry would be fruitless. The effort of the general acknowledgment of a law fixing definitely the rules of operation of the causes of motion and development of the material universe has been sought in every department of human investigation. If all kinds of matter are modifications of one kind, if all modes of motion are derived from the same energy, a great deal of difficulty is removed in consideration of causes which produce certain results. We seem to find this in the great advances which we have made in the last few years in electrical knowledge, and in the application of that knowledge to practical uses. So, too, the steadying influences of the law of evolution upon the "cell theory." Regarding this theory the fact appears to be established that all living bodies are composed of a substance which is nearly alike in all — protoplasm. This composition, in the language of Huxley, is the physical basis of life; and this substance resolved into minute cells, each cell having its own independent life makes up into the complex bodies of animals and plants, so that as regards the nature of the material of which animals and plants are composed there is little or no difference, the real difference being in the arrangement, differentiation and development of the cell. Huxley says that all the "physiological activities of animals and plants—assimilation, secretion, excretion, motion, generation—are the expression of the activities of the cells considered as physiological units. Each individual among the higher animals and plants is a synthesis of millions of subordinate individualities. With this brief and somewhat imperfect statement it may be seen that if men could master the nature, structure and metamorphosis of the nucleus of the cell he would stand, at least, on the very verge of the knowledge of the origin or principle of life. How far can he go? It was made a charge against Faraday that he believed electricity was life. There seems to be no good ground for this statement. One of his biographers declares that it may be doubted if Faraday ever tried to form a definite idea of the relation in which the physical forces stand to the Supreme Intelligence; but another states that on more than one occa-

sion when Faraday had been discoursing on some of the magnificent pre-arrangements of Divine Providence so lavishly scattered in nature, "I have seen him struggle to repress the emotion which was visibly striving for utterance; and then, at the last, with one single, far-reaching word he would just hint at his meaning, rather than express it. On such occasions, he only who had ears to hear could hear." And I remember to have read in some report of his lectures that he declared that more than once, while in the midst of some important experiment, he seemed to be on the verge of some great discovery which, almost at the moment of success, eludes his grasp. I refer to this, because as naturalists, we cannot fail to have observed an interesting statement lately put forward in the public press concerning the investigations of a man of science in a western city. Prof. Loeb, a man of considerable eminence in the University of Chicago, seems to say absolutely what Faraday, undoubtedly, came so near saying, that life is electricity, and electricity is life, and that in taking food into our system we are taking in vitality through the electricity which the food generates. In other words, electricity, instead of the dynamic, force from heat, is "the basis for muscular health and activity."

In some of his declarations Prof. Loeb has affirmed that death was not a "negative process, a simple breaking down of tissues, as it has been regarded up to this time, but an active agent born with the birth of the egg and destined, if not checked, to gain the upper hand of the life instinct and bring about extinction. But, greater even than the apparent discovery of this death agent in all substance, is Prof. Loeb's announcement that he has been able to check it in the eggs of the sea urchin at least, by means of chemical agents. This, it is claimed, means nothing less than that on a minute scale the secret of eternal life is in the power of mankind. The experiments, Prof. Loeb said, were simple. Unfertilized eggs of the sea urchin were placed in a weak solution of potassium cyanide and abandoned for several days. In ordinary conditions an unfertilized egg dies in a few hours, destroyed by the death agents born with it. At the end of several days the eggs were again examined and were found to be still capable of fertilization and of producing healthy animals." "I have no doubt whatever," said one of the greatest physicists of the United States in speaking of the subject, "that in Dr. Loeb's laboratory at Chicago or at the one in Wood's Hall, Massachusetts, life will be created, and that before long."

You will observe that Prof. Loeb really requires the egg before he can fertilize it, but another scientific man, Dr. Houghton, comes forward with what is an interesting assurance. If he cannot produce the egg he can the cell from which in time an egg may be developed. One of the lowest and simplest forms of life is what is known to the man of science as the amœba. A popular writer upon the subject says:

"It is composed of a single cell in a jelly-like substance. It is without organs of any kind. When it wants something to eat, it extends the part of its body nearest its food, in the form of a finger, draws in the food and proceeds to absorb it. When the time comes for the baby amœbas, the parent, if such it might be called, literally divides up its body, and each part becomes an independent amœba, to be divided again when the time comes. What Dr. Houghton claims is that he has produced and can produce from crystals, or dead matter, bodies that closely resemble the amœba. These artificially created bodies move just like the amœba; they absorb their food as the amœba does; they show the same chemical qualities, and they make a brave attempt at reproduction by splitting up into different cells, each displaying the same qualities as the mother cell. But there they stop. While the progeny of the real amœba keeps on dividing and sub-dividing interminably, the artificial amœba fails after the first division, and in a time, varying from half an hour to three weeks, becomes a dead mass."

If, however, life can be produced artificially from mere matter which will live through two generations what may not yet result along this line? and if it can be shown that by chemical combinations a living creation can be made, it is an easy generalization that out of this earth, once a gaseous mass, out of conditions entirely azoic, came the combinations which gave us the primal cell, and that evolution and development have done the rest. But this is proceeding too far, just now. We must be content with what we know, while we go on the search for new facts. Patiently, slowly, even with toil, must we accumulate information; and as by finding out things we add to the available state of knowledge we increase our satisfaction at the contemplation of the simplicity and the harmony of nature when we thoroughly understand her methods, and to some extent, perhaps, her purposes.

Naturally enough there has been consideration of and even anxiety over the effect of the doctrine of evolution upon our religious conceptions. You may at once understand that it is not my intention to discuss here any religious question. But it may be no harm to observe that with all his great knowledge of natural laws, Farraday remained throughout his life an adherent of a stern and simple division of the Presbyterians, and there are many able scientific men who can infer the existence of deity as easily from the regularity of the laws of nature as from the irregular operation of any of these laws. No doubt a great change in our knowledge of natural laws affects every department of human thought, and we are led to inquire more closely into what is history and which is legend. But we can perceive that an important phase of a supposed conflict between science and religion has passed and that no injury has resulted to either. Science cannot yield her place or surrender her facts, neither can she suppress or even ignore emotions, consciousness, aspirations or convictions which are not within her domain. It may be indeed, as Mr. Leslie Stephen found out, that evolution alarms religious minds by what might appear to be its ultimate tendency. "To have the origin of organic beings," he says, "brought to a period at which no life existed is to imply that nothing except matter exists, and that we are but a whirl of atoms."

Yet Mr. Stephen is also able to see that evolutionism—the systematic application of the principle of continuity to every department of thought—helps us to distinguish principles from dogmas and legends, and to estimate the forces which have been at work, which *are* at work, upon the moral nature of mankind; and he justly says: "Religion is an essential part of human nature. Men must always need some theory of the world, and of their position in it, as consistent as possible with the best established truths, some mode of uttering the emotions and of setting forth the ethical ideals congenial to the theory, and a social organization which may help to soften, purify and elevate human relations. The evolutionist perceives the importance of making the prominence of theory strong and sound—such as may have nothing to dread from the moral unequivocal acceptance of the results of scientific and historical enquiry. Therefore, however, great may be the change, the evolutionist must recognize the true value of the religious instinct in its place, and admit the best importance of finding a mode of embodying it in the future. How that is to be done is the great problem of the coming generations."

I began these somewhat detached observations with a reference to the beginning of our organization forty years ago. How will it be forty years hence? Will Dr. Matthew, Dr. Hay and Mr. Kain and Mr. Lovitt, and Mr. Banks, and Mr. Stead, and Mr. Shaw, and Mr. McIntosh, and Prof. W. F. Ganong, and all of our fellow workers and inspirers, have covered completely their chosen fields of labor, and reached the outer bounds of knowledge with respect to life organic and inorganic in this province. Will our provincial park and reserve be the happy home of our native fauna, innocent of the lumberman's axe, and immune from the sportsman's gun? Will our museum be more completely housed and all of its treasures more effectively displayed for our information and our pleasure? No doubt you will say that these are vain questions. Perhaps they are.

We may only hope that the Chicago professor will so readily and so rapidly write out his theorem respecting the physical basis of life, so speedily develop the life-continuing elixir that we may all participate, and thus have the opportunity to assemble here forty years from now and see for ourselves with our mortal eyes just how things are. The prolongation of our longevity, even by any physical, chemical, or electrical appliance invented at Chicago or elsewhere, would not, I am sure, lessen our friendship or weaken our moral forces or dilute the strength of our intellectual and spiritual consciousness.

REPORT ON ARCHÆOLOGY.

During the past year considerable field work was done in this department. In July I visited Albert County, and spent some time examining the region adjacent to the Shepody river. I was not able to find any ancient Indian village sites on the Shepody river, but this is not surprising, as the conditions there are not favorable for a hunting and fishing people.

There is, however, a fairly well marked camp site on the northwest side of the Germantown Lake. Here on a flat by the lakeside, on the farm of Mr. Berryman, a number of flints have been found, and the situation is in every way favorable both for fishing and for hunting.

The Honorable A. R. McClelan informed me that many years ago he had found a stone axe on the hillside above the village of Riverside.

Prof. W. F. Ganong accompanied me on this trip, and made some interesting observation on the remains of the early French occupation of this region. The results of his work will appear elsewhere.

In August I proceeded to McDonald's Point, at the mouth of the Washademoak. Landing at Wright's wharf I spent some days exploring the surrounding region. Some two hundred yards to the westward of the wharf I found a "pitted stone," while at and near the wharf I found large quantities of flakes and chips of jasper, chalcedony, etc., all undoubtedly made from material procured from the quarry not far away, which have been described by Dr. G. F. Matthew.* I found one broken arrow-head, but no perfect implements. Residents have found arrow heads, gouges, celts, spear heads and scrapers here, and some of these specimens are very good. Mr. R. P. McDonald has a very fine felsite spear head inches long, and with sharp serrated edges. When found in 1877 it was perfect, but it is now broken.

From McDonald's Point I went to Lakeville Corner. Here I spent some considerable time in company with Mr. D. London, one of our corresponding members, in exploring what is to the archæologist probably the most interesting region in our province. An examination was made of the physiography of the French and Maquapit Lakes,

* Proc. Royal Soc. Canada, new series, VI, section ii, 61-69.

particularly the course of the thoroughfare. Large collections of Indian remains were made, and as a result, material is now available for study, which I believe will enable us to form a much better idea than we have hitherto had of the antiquity of man in central New Brunswick. I wish to express my thanks for the aid rendered me in this work by Mr. London.

Later in the season I spent some weeks in field work at Grand Lake. I made my headquarters at Douglas Harbor, and my excursions ranged from Indian Point to Sypher's Cove.

At the Key-hole, about two and a half miles above Douglas Harbor, a long, wide and high sea-wall confines a large pond. This pond has a small, winding outlet known locally as the "Lead." This pond is a great resort for fish, and as the outlet is narrow and shallow, it is an excellent place to catch them. For this reason, probably, the inner side of the sea-wall was occupied as a camp site in prehistoric times. On the left hand side of the highway, about a hundred yards eastward beyond the bridge over the "Lead," I made several excavations in the sand and gravel, and secured numerous fragments of aboriginal pottery. The storms and freshets of generations had piled sand and gravel over the old camp site, and at depths of three and four feet, I uncovered fragments of pottery, flakes, charred wood and charcoal. I consider this the very best place in New Brunswick to look for ancient pottery.

I also examined Grand Point, and was able to make an improved map of this point as well as of the "Key-hole."

On the east side of Douglas Harbor is pointed out the Indian Bath house of Louis Joseph, an Indian proprietor who died about sixty years ago.

While at Douglas Harbor I received aid from Messrs. Asa Balmain, David Balmain, Lemuel Colwell, Abijah Coakley and W. S. Butler, to all of whom I wish to express my thanks.

When my health will permit I hope to lay the results of my summer's work before the Society in extended and illustrated form.

Muskoka, Ont., January, 18, 1902.

REPORT OF THE COMMITTEE ON BOTANY.

There is urgent need of a new list of plants of the province that will include the many additions to our flora since Professor Fowler published his list more than twenty years ago; and also to bring the nomenclature more in accordance with the usage of botanists which prevails at the present time. A strong effort should be made by our botanists during the approaching season to accomplish this work for the Society.

The list of fungi collected, new to the province, during the past year, embraces some twenty species, several of which are rare in North America. The study of these interesting plants is now engaging the attention of several students in different parts of the province, including Miss Van Horne, at St. Andrews; Mr. Vroom, at St. Stephen; Mr. Moser, in King's County, and several others. Additions to the list will be presented next year.

The following is a list of flowering plants new or little known in the province. A list of plants collected on the borders of Maine and New Brunswick by Mr. M. L. Fernald, of the Botanic Garden, Cambridge, Mass., and accompanied by specimens has been presented by that gentleman to the Society. He has for years manifested a deep interest in our botanical section, and merits our hearty thanks for his help and encouragement.

1 Clematis verticillaris, D. C. New Canaan, Queens County. J. Moser. A new station near St. Stephen. J. Vroom.

6 Anemone riparia, Fernald. Dry open woods. Four Falls. M. L. Fernald.

60 RAPHANUS RAPHANISTRUM, L. Of late years becoming a very troublesome weed in Charlotte County. J. Vroom.

63 Viola lanceolata, L. In different parts of Charlotte County. J. Vroom.

64 V. primulæfolia, L. Quite frequent on banks of St. Croix River, above Sprague's Falls. J. Vroom.

68 V. cucullata, Ait. As heretofore understood in New Brunswick, this species must be divided into several, of which, probably, the true V. cucullata is among the least common. The group needs study.

68a **Viola ovata,** Nutt. A violet found some years ago on the shore of Lake Utopia should probably be referred to this species, which occurs near Bear River, Nova Scotia.

69 Viola Labradorica, Schrank (= V. canina, var. Muhlenbergii of last year's report, and V. canina, var. sylvestris, of former lists). In wet soil under trees near St. Stephen. J. Vroom.

69*a* Viola subvestita, Greene. Much more abundant and showy than V. Labradorica, with which it has been confused. It grows on dry hill tops in and near St. Stephen, and is probably the form reported from other places in the province under the name of V. canina, var. sylvestris. Easily distinguished from V. Labradorica by its habitat, and by its deep violet color, as dark as the darkest of our stemless blue violets, and more reddish in hue. [In Prof. Greene's description of V. subvestita (Ottawa Naturalist, December, 1901), the bractlets are said to be very near the flower, and notably auriculate at their base. These characters are not very evident in the St. Stephen plant.] J. Vroom.

122*a* **Ilex glabra,** Gray. Found in Shelburne County, Nova Scotia, by Mr. C. S. Bruce.

125 Vitis riparia, Michx. A single plant seen on the bank of St. Croix river, above Sprague's Falls, 1899. J. Vroom.

125*a* **Vitis Vulpina,** L. Gravelly bank of Aroostook river, Four Falls, Victoria County. M. L. Fernald.

147*a* **Astralagus elegans,** (Hook) Britton. Aroostook Falls. M. L. Fernald.

165*a* **Spiræa Sorbifolia,** L. Old pastures. Aroostook Junction. M. L. Fernald.

191*a* **Agrimonia striata,** Michx. (See *Rhodora*, ii, 237). Sent from Digby, N. S., by Mr. N. W. Hogg.

257 Cornus circinata, L'Her. Bank of Aroostook river, Four Falls. B. L. Robinson and M. L. Fernald.

268 Viburnum Lentago, L. Abundant on Blood Island, St. Croix River.

270*a* Triosteum perfoliatum, L. Rich wooded banks of Aroostook river, Four Falls, Victoria County. M. L. Fernald.

307 Aster Lindleyanus, Torr and Gray. Dry woods. Four Falls. M. L. Fernald.

347 ARTEMISIA ABSINTHIUM, L. Dry borders of woods, Grand Falls. M. L. Fernald.

363*a* HIERACIUM AURANTIACUM, L. Rapidly spreading as a weed in hay fields in different parts of Charlotte County. J. Vroom.

433*a* Gentiana rubricaulis, Schwein (= G. linearis, var. latifolia, Gr.) Dumbarton (the third station reported in Charlotte Co.) J. Vroom.

434*a* **Bartonia tenella,** Muhl. Shelburne, N. S. C. S. Bruce.

446 ECHIUM VULGARE, L. Welsford, Queens County. G. U. Hay.

494 Calamintha Clinopodium (L.) Kuntze (Satureia Clinopodium, Carnel). Alluvial soil. Four Falls. B. L. Robinson.

582*a* Salix glaucophylla, Bebb. Gravelly beach of Aroostook river, Four Falls, Vict. Co. M. L. Fernald. A form with pubescent twigs found at the same place.

583 Salix nigra, Marsh. Washademoak Lake and Canaan Forks, Queens Co. J. Moser. Brandy Point, St. John River, Macoun and Hay.

583*a* **S. sericea,** Marsh. Washademoak Lake. Rare. J. Moser.

586 Salix myrtilloides, L. (This willow, found last summer in Magnerawaak meadow, Calais, probably occurs on the Canadian side of the river. J. Vroom).

639*a* **Smilax rotundifolia,** L. Found at Lake Annis, near Yarmouth, Nova Scotia, by Mr. D. Soloan ; and near Shelburne harbor, N. S., by Mr. C. S. Bruce. (This and the other plants named above from Nova Scotia may be looked for in New Brunswick.)

713 Naias flexilis, Rostk. St. Croix River, below Grand Falls (the second station in Charlotte County). J. Vroom.

939*a* Lycopodium clavatum, L. Var. **Monostachyon,** Hook. Open spruce woods, Grand Falls. M. L. Fernald.

940 L. complanatum L. Open woods. Grand Falls. B. L. Robinson and M. L. Fernald. (The typical form with more distinctly dimorphous and narrower leaves and less erect and bushy branches than the variety *Chamæcyparissus*.

940*b* L. sabinæfolium, Willd. Open spruce woods. Grand Falls. B. L. Robinson and M. L. Fernald.

OBSERVATIONS OF PLANTS, 1901.

After a winter of severe though not intensely cold weather and abundant snow, the spring opened in early April with many warm days during which the grass grew rapidly. In later April and early May cold east winds prevailed. Tussilago farfara (coltsfoot), one of the earliest plants to appear, was observed in bloom by the side of the street opposite the Custom House, St. John, April 23rd.

WILD GARDEN AT INGLESIDE, KINGS COUNTY.

May 1st.—In the wild garden, at Ingleside, Viola blanda and Epigæa repens were observed in full bloom. In exposed places a few strawberry blossoms were appearing. The red maple was coming into bloom, and the Dog-tooth Violet (Erythronium Americanum) blossoms were beginning to open.

May 10th.—A beautiful day—warm and spring-like—followed by three days of rain. Temperature moderate, grass growing rapidly and buds on the trees bursting into leaf, the white birch leading. Red maple blossoms falling. Sanguinaria Canadensis in bloom. Blue violets coming in flower, Dog-tooth Violet, the Gold Thread, Grove Anemone and Mountain Fly Honeysuckle (Lonicera ciliata) in full bloom. A few plants in bloom of the Painted Trillium, Dandelion, Marsh Marigold, Strawberry, Bluets, the involucral blossoms, of broad leavedViburnum, (V. lantanoides), Purple Trillium, Bellwort (Uvularia sessilifolia). The Woodsias and other small ferns on the rockeries with fronds nearly expanded.

May 17th.—In full bloom—Blue violets, Purple and Painted Trilliums, Strawberries and Dandelions, Marsh Marigold, the Fetid Currant (Ribes prostratum). Coming into bloom were the Amelanchier Canadensis, central blossoms of Viburnum lantanoides, Thaspium aureum, and a few blossoms were appearing of Rhodora, Vaccinium Canadense, and the wild red cherry. Of the trees—white birches, lilacs, black cherry (Prunus serotina), Viburnum lantanoides, mountain fly honeysuckle, hazel, hawthorne, mountain ash, were in full leaf. The leaves of poplars, horsechestnuts, and white maples were just unfolding ; also those of the smaller trees of red maples and the Amelanchiers, the latter very beautiful from the contrast of the purple leaves and the white blossoms. The delicate yellowish-green of the

unfolding leaves of the aspen (Populus tremuloides), the greenish-white of the poplar (Populus grandidentata), and the delicate green of the Lombardy poplar added to the almost indescribable variety of coloring in the groves and woodlands. The shrubs and trees not native, chiefly those from the Central Experimental Farm, nearly all in leaf.

May 25th.—The white petals of Amelanchier falling. Plants in full bloom—Prunus Pennsylvanicum, Cornus Canadensis, Corallorhiza innata, Trientalis Americana, Rhodora Canadensis, Vaccinium Canadense, Trillium grandiflorum (not native), Trillium cernuum, Viola Watsoni (not native), V. pubescens, Menyanthes trifoliata, Oxalis corniculata, Aralia nudicaulis, Actæa alba, Clintonia borealis. The blossoms of the Stemless Lady's Slipper (Cypripedium acaule) just unfolding. The following named trees and shrubs just coming into leaf: Quercus rubra, Acacia, Rhus typhina, Ilex verticillata Viburnum opulus, Fraxinus sambucifolia; also the leaves of the ivy Ampelopsis quinquefolia) on the cottage.

June 1st.—After a week of wet, cold weather, June came in bright and warm. The weather was so warm on June 2nd that shade from the sun's rays was grateful. Warm showers alternated with the bright sunshine and vegetation was rapid. The nights remained cool in early June up to the 15th and 16th, when frosts did much damage in low places along the river, killing buckwheat, strawberries and other tender plants, and wilting the fronds of what is perhaps the most sensitive of our ferns to frost—Osmunda cinnamomea. Ice formed in many places in the ponds and along the margins of the rivers and streams.

During the remainder of the summer and fall, but little rain fell. The streams became very shallow and wells were dried up. The crops which were very promising in spring and early summer, suffered greatly in later months from the prolonged drought. Fruits ripened early (ripe strawberries were found as early as June 13th) and these with raspberries and other small fruits in dry places were a scanty crop.

June 8th.—In full bloom—Lilacs, Oak-leaved Mountain Ash, Honeysuckle, Horsechestnut, Yellow and Stemless Lady's Slipper, Iris versicolor, Viburnum opulus, Pinguicula vulgaris, Geranium Robertianum, Oenothera pumila, Leucanthemum Vulgare, Erigeron Philadelphicum, Aster graminifolius, Ledum latifolium, Prunus serotina and others.

FORTIETH ANNUAL REPORT

OF THE

COUNCIL

OF THE

NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

Your Council beg to submit the following report for the year now ending:

MEMBERSHIP.

During the past year the Society has added four ordinary and seven associate members to the roll. The following shows the classes and total membership enrolled:

Honorary members	4
Life members	5
Corresponding members	22
Ordinary members	70
Associate members	110
Total membership of	211

FINANCE.

TREASURER'S REPORT, 1900–1901.

Receipts –

Balance from 1899–1900	$ 204 41	
Membership fees	39 00	
Bulletins sold	1 00	
Interest on investments	231 30	
Donations	28 83	
Government grant	300 00	
Special deposit Bank of Nova Scotia withdrawn	2,400 00	
		$3,204 54

Receipts brought forward,		$3,204 54
Expenditure—		
Printing and distributing Bulletin XIX	$ 155 48	
Maintenance of museum	74 79	
Library, books and binding	3 15	
Miscellaneous	117 58	
Loaned on mortgage Hazelhurst property	2,500 00	
Balance in Bank of New Brunswick	353 54	
		$3,204 54

The balance of $353.54 in Bank of New Brunswick includes $33.00 held in trust for the Ladies' Association.

The total funds of the Society are now represented by:

Balance Bank of New Brunswick	$ 353 54
Mortgage (Hazelhurst property)	2,500 00
Special deposit, Building Fund, in Bank of N. B.	10 00
	$2,863 54

Our interest in the Hazelhurst property is protected by fire insurance policies to the amount of $2,700.00, and the specimens, etc., are insured for $2,500.00.

A. GORDON LEAVITT, *Treasurer.*

Examined and found correct.

JAMES A. ESTEY,
THOMAS STOTHART, } *Auditors.*

LIBRARY.

The year shows a considerable increase in the library, due principally to our large exchange list. A number of works on various branches of nature study have been purchased, and several valuable books have been presented by members of the Society.

PUBLICATIONS.

Bulletin XIX has been published. It contains articles by Dr. Geo. F. Matthew, Dr. Geo. U. Hay, Samuel W. Kain, Prof. W. F. Ganong, W. McIntosh and Chas. F. B. Rowe; also a report of the Fredericton Natural History Society. Several of the shorter papers read before the Society have been published in the daily press.

LECTURES AND ESSAYS.

Nine regular meetings were held, at which the following papers were read:

1901.

Jan. 8. (a) Botanical Trip among South Tobique Lakes. Additions to New Brunswick Plants, by G. U. Hay.
(b) Changes in the River Valleys of New Brunswick, by Prof. W. F. Ganong.

Jan. 15. (c) Annual Meeting. Reports. President's Address.

Feb. 5. (a) Sketches of Bird Life, by A. Gordon Leavitt.
(b) Native Plants in Rockwood Park, St. John, by G. U. Hay.
(c) Catalogue of New Brunswick Plant Formations, by Prof. W. F. Ganong.

Mar. 5. (a) Mountain, Lake, and River Scenery in New Brunswick, by Prof. L. W. Bailey.
(b) A Plea for certain Birds, considered destructive, by J. W. Banks.

April 2. (a) Insect Life in the Nerepis Valley, by W. McIntosh.
(b) Physiography of the Digdeguash Lake Basin, by Prof. W. F. Ganong.

May 7. An Evening with the Microscope, by Members of the Section on Microscopy.

June 4. (a) Note on the Possibility of Developing Power by the Movement of Tides at the Falls, by Prof. A. W. Duff.
(b) Morphology of New Brunswick Water Falls, by Prof. W. F. Ganong.
(c) Report of Delegate to Royal Society.

Oct. 1. (a) Random Notes on Cape Breton, (b) Additional Notes on the Cambrian of C. B., with descriptions of new species, by G. F. Matthew, D. Sc.

Nov. 5. (a) Observations on a Summer's Work, by L. W. Bailey, Ph. D.
(b) Notes on the Physiography of the Tu-a-dook (Little Southwest Miramichi) Lake Basin, by W. F. Ganong, Ph. D.

Dec. 3. (a) Our Forests and their Inhabitants, by W. A. Hickman, M. A.
(b) Preliminary List of Coleoptera of New Brunswick, by William McIntosh.
(c) On the Physiography of the Tobique-Miramichi Water Shed, by W. F. Ganong, Ph. D.
(d) Observations in Wild Garden at Ingleside, by G. U. Hay, D. Sc.

In addition to the above, an elementary series of lectures was delivered, viz:

Jan. 22. (a) Depths of the Ocean.
29. (b) Tides and Erosion of the Bay of Fundy, by Dr. Geo. F. Matthew.

ARCHÆOLOGY.

Mr. S. W. Kain has been doing some very valuable archæological work in the vicinity of Grand and Maquapit Lakes during the past summer.

This region owing, no doubt, to the abundance of fish and game, was a favorite camping ground of the Indians, and, in exploring these ancient camp sites, Mr. Kain discovered a large number of stone implements, consisting of arrow-heads, stone-axes, hammer-stones, celts, and many fragments of aboriginal pottery. A number of these fragments show ornamentation distinct from any hitherto observed in New Brunswick specimens of the Indian potters' art. All the articles collected were presented to the Society.

While at Grand Lake Mr. Kain purchased for the Society a large number of relics of the New Brunswick stone age from local collectors.

GEOLOGY.

Dr. Matthew has been doing some geological work in Cape Breton and New Brunswick during the past summer. Among interesting additions to our knowledge of Cambrian geology from the former region, is the discovery of two new faunas in the Cambrian—one in the flags corresponding to those in St. John, this is the Upper Paradoxides fauna. The other is the Tremadoc fauna of Wales, whose place at St. John would be in the channel of the river at the Straight Shore, therefore inaccessible here.

Dr. Bailey has done a summer work for the Geological surveys of Canada in Central and Eastern New Brunswick; in the former district he has found extensive areas of Upper Silurian slates, and in the latter has been investigating the probable occurrences of coal and oil.

Mr. Kain's discovery of submerged fire-places of the stone age seen in Maquapit Lake are referred to in the report of the Geological Committee.

WARPING OF THE EARTH'S CRUST NEAR ST. JOHN IN RECENT TIMES.

By the term "recent times," in the above title, is intended times geologically recent.

Assuming that Post-Pleiocene time closed with the emergence of the Leda clay and the formation of the Saxicava, or Macoma sands, the

overlying, bog, marl, and marsh deposits, will be included in recent deposits.

Certain phenomena observed in Southern New Brunswick, involving these deposits, indicate a differential sinking of the land in portions of the interior which are best explained as a warping of the earth's crust.

About twenty-five years ago, excavations of the marsh-mud in Harris' Cove, fourteen miles from the mouth of the Kennebecasis river, were made for the purpose of obtaining fertilizer. It was found that for five feet below the present low water summer level of the river there were marsh surfaces, indicated by layers of partly decayed marsh grass, with roots and attached leaves.

These marsh grasses could not have grown under present conditions, but must have flourished when the mud in which they grew was at a level considerably higher, relative to the water level of the river, than it is now.

Two possible causes of this former condition of the Kennebecasis river may be suggested in explanation, one that the upper part of the river stood at a higher level relative to the lower part than it does now. The other is that there existed formerly a lower outlet of the river than the present one at the Falls of the St. John.

The second possible cause of a lower outlet is not borne out by any indications of a lower discharge for the waters of the St. John since Post-Pleiocene time. Except the rock-bottomed passes of Drury's Cove and the present outlet, all other possible passages are at present filled with Post-Pleiocene deposits.

Even if the passage at the "Falls" had been lower in former times, it would not mend the mattor, for at present the level of the water in St. John harbor at high tide is about six or eight feet above the summer level of the water in the Kennebecasis river. The only result, therefore, of a lowering of the barrier would be to flood the Kennebecasis marshes at high tide and prevent the marsh growth, even at the present level.

With the opening of the barrier it would be necessary that there should come a reduction in the height of the Bay of Fundy tides, in order that the marsh-plants might flourish in Harris' Cove five feet below the present summer level. Such an assumption is gratuitous, and without any evidence in fact.

With the constant wear on the crown of the reef at Union Point in the "Falls" it might be supposed that the tides would gain more and have easier access to the river. But it seems a question whether this cause of abrasion—the rushing water with its load of mud and sand—has had any appreciable effect in historic times in reducing the height of the barrier; and there certainly has been a countervailing force at work, tending to lift the barrier higher.

In a former Bulletin attention was called to a force operating later than the glacial period to raise certain portions of the solid rocks around St. John. Of this, evidence may be seen on the hillside south of the "valley" in St. John, where, in a short space on the slope of the hill, the rocks have been raised five feet since the glacial period. There seems nothing to indicate subsidence at the barrier at the "Falls," and whatever evidence there is, favors elevation.

It would seem then that we are forced to regard differential uplift, or in other words, warping of the earth's crust, as the cause of the phenomenon observed in Harris' Cove. And, further, it would seem that this movement was slow and continuous, as there were not only marsh-surfaces at five feet below the present marsh only; but the marsh-surface was many times renewed, from the lower layers observed to the present surface.

As bearing upon the phenomenon of the drowning of the upper part of the lower Kennebecasis valley since Pleistocene times, one might call attention to a like condition of things effecting the valley of the St. John river, as observed by members of this Society, when the summer camp of observation was held by it at French Lake some years ago.

During exploration along the south shore of the Maquapit Lake a curious short creek was observed without outlet, save two, close together, on the lake shore. This short creek seemed to be a bend or loop of a creek, once existing, which had been obliterated, except for this bend, by the encroachment of the lake.

One of our members, Mr. S. W. Kain, who spent some time at Maquapit Lake last summer when the water of the river was low, has traced this submerged creek under the shallow water at the south end of the lake, and found that Ring Creek is indeed a bend of what was formerly a continuous creek or thoroughfare from French Lake to Grand Lake. And further, he made the interesting discovery that

along the banks of this drowned creek, under the shallow waters of Maquapit Lake, can be seen collections of stones in some places, such as the Indians would leave, of their camp fires, where they had lived alongside the creek; stone implements and other indications of aboriginal occupancy were also found at these places.

Evidences of camp fires of the aborigines along this submerged water-way shows that the subsidence of this area was prolonged into a comparatively late period, since such fresh marks of Neolithic occupancy can be found.

A closer study of the sunken area in this part of the valley of the St. John river would probably give interesting and valuable results.

Ornithology.

The Ornithological Committee report that the year has been an exceedingly quiet one as far as new material is concerned.

At present they have under consideration the preparation of a catalogue of specimens in the museum, which, when completed, will fill a long felt want.

The specimens have, as usual, been the centre of attraction to the majority of visitors.

Entomology.

The Entomological Committee report that during the past year over 2,500 specimens have been collected by members of the Society. Not only has a great deal of valuable field work been done, but the majority of the specimens taken have been determined by specialists.

Field Work.

Two field meetings were held under the auspices of the Society during the past summer, one at Ingleside, August 24th, and the other in Rockwood Park in September. Both were well attended. The one at Ingleside occupied the whole day. In the morning the members of the Society and their friends examined the plants in the wild garden, and in the afternoon a visit was made to a hill near Brandy Point overlooking the St. John river. Here the meeting was called to order by the president, Hon. J. V. Ellis, and an address was given by Dr. Matthew on the geology of the locality, linking with it a very interesting history of the St. John river valley in ages past. G. U. Hay followed with a talk on the plants found in the neighborhood,

their habits, uses, and the many curious ways they adapt themselves to their surroundings. W. A. Hickman gave an address on evolution and some tendencies of modern science. Prizes were awarded in geology and botany for collections found during the day.

At the meeting at Rockwood Park some of the most interesting natural features of that beautiful locality were examined, including the geology and botany. At the conclusion of the afternoon's outing the members were hospitably entertained at Dr. Matthew's home, and prizes were awarded to successful competitors in geology and botany.

Your committee would suggest, that as there are difficulties in the way of holding a summer camp at a distance from the city, a series of field meetings on a more extended scale than heretofore be held during the coming summer. One at Ingleside, or some point on the St. John river, or C. P. R., in which some effort should be made to have the Fredericton Natural History Society unite; one on the Kennebecasis river, in which the Kings County Society may share, one to the west, and another to the east of St. John city, and one on the sea shore—five in all.

And your committee would further suggest that adequate prizes be provided that shall reward certain definite efforts, which it is hoped may be put forth by our own younger members, to make collections of specimens of natural history in the places visited, these prizes to be awarded at the next annual meeting when the collections made shall be exhibited and become the property of the Society.

G. U. HAY, *Chairman.*

GENERAL.

The museum has been open to the public on Tuesday, Thursday and Saturday afternoons, and, as the register shows, has attracted many visitors.

We regret that other duties make it necessary for Miss McBeath to retire from the office of assistant curator. Three years ago the museum was opened to the public three afternoons of each week with Miss McBeath in charge, and the success which has attended this movement is largely due to the courteous and efficient manner in which she performed the duties of her office.

The council wish to express their thanks for the very hearty co-operation and valuable work done by the associate members. The

many improvements seen in the library are due to the efforts of the ladies' branch, and the general work of the Society owes its success, in no small measure, to their efficient assistance.

To the press of St. John our thanks are due for the free insertion of notices and reports, and for the publication of articles from time to time. The council also wish to thank those who have delivered addresses or lectures before the Society.

While reviewing the past year we do not find so many remarkable features as in the preceding one. But we feel satisfied in considering it a year of more than average progress. There has been a gain in membership, and we have had a considerable increase in our grant from the provincial government.

In archæology, geology, botany and entomology much important field work has been done. Our lecture course has been varied and interesting, and our meetings well attended.

Respectfully submitted,

W. McIntosh,
Secretary to Council.

DONATIONS TO THE MUSEUM, 1901.

DATE.	DONOR'S NAME AND DESCRIPTION OF GIFT.
Feb. 5	Dr. Geo. F. Matthew, St. John. Two Colored Charts, Bay of Fundy.
	Mrs. Baxter, St. John. Two Specimens of Fossil Plants.
Mar. 5	Miss Georgie E. Carry, Shreveport, La. Miniature Bale of Cotton.
Apr. 2	D. Ferguson, Esq., Chatham. Two Bayonets, a Shoe-buckle, and two Knife or Spearblades.
	Stanley Thompson, St. John. Two Specimens Rock Crystal, from Sheet Harbor, N. S.
Oct. 1	S. W. Kain, Esq., St. John. Stone Implements and Pre-historic Pottery, from Grand Lake Region.
	A. Gordon Leavitt, Esq., St. John. Shells from Nerepis River.
	Stanley Thompson, St. John. Native Woods.
	S. A. Coakley. Pisolithic Iron Ore.
	Dr. W. D. Matthew, New York. Series of Photographs of fossil remains of Pre-historic Horse.
Nov. 1	Geoffrey Stead, Esq., C. E., St. John. Copper Ore.
	Prof. L. W. Bailey, Ph. D., Fredericton. Fossils and Geological Specimens.

DONATIONS TO THE FUNDS.

Anonymous $28 83

DONATIONS TO THE LIBRARY, 1901.

Donor's Name.	Residence.	Work.
Mrs. Geo. A. Hamilton	St. John	Books.
Prof. W. F. Ganong	Northamp'n, Mass.	1 year's Subt. to Science
Mrs. John Berryman	St. John	Books.
Royal Society of Canada	Ottawa	Proceedings.
Geological Society	Manchester	Transactions.
Royal Colonial Institute	London	Journals.
Marine Biological Association, U. K.	London	Journals.
Geographical Journal	London	
Royal Gardens	Kew, England.	Bulletin.
British Museum	London	Hand List of Birds.
New Zealand Institute of Science	Hobartown	Proceedings.
Western Australian Government	Perth	Mining Stat., (Gazette.)
N. S. Wales Linnæan Society	Sydney	Proceedings (Abstract.)
Smithsonian Institution	Washington	Reports.
New York Academy of Science	New York	Jour., Annals, Memoirs
Academy of Natural Sciences	Philadelphia	Proceedings.
Field Columbian Museum	Chicago	Reports and Bulletins.
Wyoming Historical and Geological Society	Wilkesbarre	Proceedings.
American Museum Natural History	New York,	Bulletins, Report.
Wisconsin Natural History Society	Milwaukee	Bulletin.
Indiana Department of Geology	Indianapolis	Reports.
Newport Natural History Society	Newport, R. I.	Proceedings.
Natural Science Association	Staten Island	do.
South Dakota School of Mines	Rapid City	Bulletins.
New York Public Library	New York	do.
Cornell University	Ithaca, N. Y.	do.
Hamilton Scientific Society	Hamilton	
University of Toronto	Toronto	Studies.
Morphology of Central Cylinder in Angiosperms	..	By E. C. Jeffrey.
Library and Scientific Society	Ottawa	Transactions.
Entomological Society of Ontario	London	Canadian Entomologist
Historical and Scientific Society of Manitoba	Winnipeg	Reports and Transac.
Department of Inland Revenue	Ottawa	Bulletins.
Dalhousie University	Halifax	Calendar.
Royal Society	London	Proc., Rep'ts. Year Bk.
Maryland Geological Survey	Baltimore	Atlas, Eocene.P-Am.Ex
Wisconsin Academy of Science, Arts and Letters	Madison	Transactions.
School of Geography	Lancaster, Pa.	Journals.
University of Michigan	Lansing	Bulletins.
Linnæan Society	New York	Abstract.
U. S. Commissioner of Agriculture	Washington	Circul'rs, Bul'ts, Repts.
U. S. Geological Survey	Washington	Mono'gphs, Rpts, Bul'ts
Canadian Institute	Toronto	Proceedings.
Department of Inland Revenue	Ottawa	Bulletins.
Johns Hopkins University	Baltimore	Circulars.
Connecticut Academy of Arts and Science	New Haven	Transactions.
New York State University	Albany	Report.
McGill University	Montreal	Papers.
Essex Institute	Salem, Mass	Magazine, Can. Erb.
Natural History Association	Miramichi	Proceedings.
California Academy of Science	San Francisco	do.
Colorado Scientific Society	Denver	Proc. College Studies.
Australian Museum	Sydney, N. S. W.	Records, Reports.
Rochester Academy of Science	Rochester, N. Y.	Proceedings.
University of California	Berkley	Bulletins
Director of Bureau of Ethnology	Washington	Annual Reports.
Public Museum	Milwaukee	Annual Reports
Geological Society	London	Abs. of Proceedings.
Missouri Botanical Gardens	St. Louis	Report.
Ohio State University	Columbus	Report.
Society of Natural Sciences	Buffalo	Bulletin.
Society of Natural History	Boston	Proceedings.

DONATIONS TO THE LIBRARY.—CONTINUED.

DONOR'S NAME.	RESIDENCE.	WORK.
Lloyd Library	Cincinnati	Bulletin.
Society of Natural History	Cincinnati	Bulletins.
Museum Association	Cincinnati	Annual Report.
Astronomical Society	Toronto	Transactions.
U. S. Coast and Geodetic Survey	Washington	Report.
U. S. Fish Commission	Washington	Bulletin.
Iowa Geological Survey	Des Moines	Report.
Minnesota Academy of Natural Sciences	Minneapolis	Bulletins.
Society of Natural History	Portland	Bulletin
Geological Survey	Ottawa	Reports, Maps.
Yorkshire Geological and Polytechnic Society	Leeds	Proceedings.
Biological Society	Liverpool	do.
Geological Society	Liverpool	do.
Museum's Journal	Sheffield	do.
Academy of Science	St. Louis	do.
Nova Scotia Museum	Halifax	Report.
Field Naturalist Club	Ottawa	Ottawa Naturalist.
National Museum	Montevideo	Annals.
Feuille des Jeunes Naturalistes	Paris	Journal.
Societe Geologique de Belgique	Liege	Transactions.
Geological Institution	Upsala	Bulletin.
Societe Scientifique du Chile	Santiago	do.
U. S. Weather Bureau	Washington	Weather Review Rep'ts
Colorado College	......	Studies.
Experimental Farms	Ottawa	Bulletins.
Indiana Academy of Science	Indianapolis	Proceedings.
Institute Geologico de Mexico	Mexico	Bulletin.
Crown Land Department of New Brunswick	Fredericton	Annual Report.
Royal Academy of Science and Arts	Barcelona	Bulletin.
Imperial Academy of Science	St. Petersburg	do.
Field Naturalist Club	Ottawa	Canadian Botany.
Field Naturalist Club, Sir Wm. Dawson	Ottawa	Bibliography.
Royal Academy of Science	Stockholm	Proceedings.
Royal Societe Malacologique Belgium	Brussels	Bulletin.
Queen's Quarterly	Kingston	Journal.
Public Library	Toronto	Catalogue.
Department of Agriculture	Ottawa	Bulletin.

PURCHASED.

Chambers' Cyclopedia of English Literature. Two Volumes.

Hicker's Epidemics of Middle Ages.

Archaia. By Sir J. W. Dawson.

Drew's Chronological Chart.

Statistical Year Book of Canada.

LIST OF MEMBERS.

HONORARY MEMBERS.

Bailey, Prof. Loring W.... ....Fredericton.
Ganong, Prof. W. F.... ....Northampton, Mass.
Laflamme, Monsignor J. C. K.... ....Quebec.
Marr, Prof. John E ....Cambridge, G. B.

LIFE MEMBERS.

Chamberlain, M.... .... Boston, Mass.
Hegan, James B.*.... ....Charlottetown.
Hay, George, U.... .... St. John.
Matthew, R.*.... ....Cienfuegos, Cuba.

CORRESPONDING MEMBERS.

Baxter, Dr. John.... ....Chatham.
Brittain, John.... ....Fredericton.
Butler, W. S.... ....Butler, Queens County.
Chalmers, Robert.... ....Ottawa.
Cox, Dr. Philip.... ....Chatham
Duncan, Dr. G. M.... ....Bathurst, N. B.
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Gesner, G. W.... ....New York.
Gilmor, Dr.... ....Quaco.
London, Duncan ....Lakeville Corner.
Hickman, W. Albert.... ....Pictou, N. S.
Kirkland, Dr. R. J.... ....Grand Rapids, Michigan.
Livingstone, Colin H.... ....New York.
McLaughlin, D. J. W.... .... Grand Manan
Matthew, Rev. C. R.... ....Kingsville, Ont.
Matthew, Dr. William D.... ....New York
Moore, W. A.... ....York County.
Perkins, Henry.... ....McAdam, N. B.
Smith, Dr. A. C.... .... Tracadie, N. B.
Trueman, Geo. J.... ....Sackville.
Vroom, James.... ....St. Stephen, N. B.
Wilson, W. J ....Ottawa.

* Members since organization in 1862.

Ordinary Members.

Addy, H. Geo. M. D.
Allan, W. Watson.
Barnhill, Geo. E.
Bowden, Wm. C.
Burdett, W. F.
Bustin, S. B.
Banks, J. W.
Campbell, J. Roy.
Clarke, C. P.
Day, Geo. A.
deSoyres, Rev. J.
Ellis, Hon. J. V., LL. D.
Ellis, W. L., M. D.
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Fisher, W. S.
Flood, Edward H. S.
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Kingdon, Right Rev. Dr.
Kinnear, Harrison
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Lordly, Henry R., C. E.
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Melvin, Dr. G. G.
Morrisey, Alfred
Mowatt, Jas.
Mowatt, W. H.
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McKinnon, John
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Stothard, Thomas
Thompson, Enoch
Vroom, Wm. E.
Walker, James, M. D.
Waring, Geo. H.
Wetmore, Dr. H. C.
Wilson, J. E.
Wilson, LeBaron
White, W. W., M. D.
White, Wm.

Junior Member.

Murdoch, Robert.................................. ....

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Adam, Miss Helen
Addy, Mrs. H. Geo.
Allan, Mrs. W. Watson
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Barker, Miss Lizzie G.
Barker, Miss Kate
Black, Mrs. S. McCully
Bowden, Mrs. William
Bowden, Mrs. Wm. C.
Boyer, Miss
Brown, Miss Ina S.
Bustin, Mrs. S. B.
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Colwell, Miss Emma
Connell, Miss M.
Connell, Miss E. Joyce
Cotter, Miss Kate A. M.

* Member since organization in 1862.

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Schofield, Mrs. John K.
Scovil, Mrs. G. E.
Sears, Mrs. Edward
Seely, Mrs. J. Fred.
Seely, Miss Jean
Sharpe, Miss M. C.
Shaw, Miss M. H.
Sheffield, Mrs. M.
Smith, Mrs. Morton
Smith, Miss M. Barry
Starr, Mrs. R. P.
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Wetmore, Miss I.
Whitney, Mrs. Jas.
Wright, Miss
Yerxa, Miss Ivy

OFFICERS AND COMMITTEES OF THE NATURAL HISTORY SOCIETY FOR 1902.

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His Honor the Lieutenant Governor, Honorable J. B. Snowball.

COUNCIL FOR 1902.

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Rooms — Dr. H. Geo. Addy, Mrs. Geo. F. Matthew, Mrs. W. S. Hall, Mrs. G. U. Hay.

METEOROLOGICAL ABSTRACT FOR 1902.

OBSERVATIONS RECORDED AT ST. JOHN OBSERVATORY, LATITUDE 45° 17′ N. LONGITUDE 66° 4′ W.

D. LEAVITT HUTCHINSON, *Director*.

	Barometer.			Thermometer.			Clearness: 0 = clear; 10 = wholly clouded.	Precipitation: Rain and melted snow.	Wind Direction and Velocity.																		Thunder Storms.
									N.		N. E.		E.		S. E.		S.		S. W.		W.		N. W.				
	Mean.	Highest.	Lowest.	Mean.	Maximum.	Minimum.			Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours Calm.	Total Miles.	
January	29.94	30.57	28.80	19.6	42.5	−14.8	7	4.73	93	943	221	2713	15	132	37	588	10	97	59	920	30	254	241	3452	38	9,099	0
February	29.57	30.08	29.04	19.5	38.7	3.1	5	0.99	71	921	42	642	1	16	3	36	3	28	79	843	24	176	432	7097	17	9,759	0
March	29.91	30.46	29.52	29.8	48.7	−1.5	7	3.21	60	485	96	682	30	195	108	1658	52	473	144	2162	76	593	141	2276	42	8,524	0
April	30.13	30.57	29.54	43.9	64.8	25	7	3.56	5	56	307	3930	50	370	185	2354	65	298	37	197	5	15	3	9	63	7,229	0
May	29.96	30.30	29.39	49.4	69.6	32	7	4.07	35	513	133	1328	41	413	71	670	97	533	200	2323	14	92	13	111	50	5,983	1
June	29.98	30.31	29.70	57.9	78.6	40.6	6	6.84	21	162	67	815	21	259	13	136	144	1073	380	3373	10	59	54	763	10	6,640	3
July	29.92	30.32	29.65	63.4	84.3	49	5	1.16	70	516	22	195	53	319	22	96	176	973	231	1800	47	314	66	666	57	4,879	2
August	30.09	30.34	29.76	65.1	78.5	52	5	1.47	70	565	44	489	19	105	6	79	192	1209	286	2646	45	319	49	673	31	6,085	1
September	30.03	30.48	29.61	58	80.3	40	5	3.35	94	948	44	389	7	60	11	80	105	799	282	2660	23	187	99	1762	55	6,885	0
October	30.05	30.69	29.31	48.5	63.5	31.2	6	1.51	115	1108	39	349	...	...	27	308	57	655	266	3753	42	317	159	2649	39	9,139	1
November	29.87	30.45	28.92	35.1	56.4	13	7	3.24	161	1687	142	1534	23	312	17	229	19	483	74	1260	38	392	208	3491	38	9,388	0
December	29.95	30.67	29.28	27.4	51.1	−2	7	4.99	142	1418	170	2175	8	93	69	1627	22	327	108	2328	50	575	162	2688	18	11,180	0

Barometer readings have been reduced to sea level and 32° Fahrenheit. The minus sign when used, indicates temperatures below zero, The maximum temperature, 84.3, was registered on the 15th July; the minimum, 14.8 below zero, on the 20th of January. The total precipitation for year was 39.12 inches.

ST. JOHN, N. B.,

May 1st, 1902.

Dear ....

I send you with this a statement of your account with the Natural History Society of New Brunswick up to January 1st, 1903. The expenses of the Society are somewhat heavy this year, especially in the publication of its annual Bulletin, which is much larger and entails a greater cost than usual. You will therefore confer a favour by sending me the amount of your indebtedness to the Society as soon as you conveniently can.

Yours very truly,

G. U. HAY,
Secretary.

32 Wellington Row,

NATURAL HISTORY SOCIETY
OF
NEW-BRUNSWICK.

ANNUAL REPORT—1863.

The Council of the Natural History Society in presenting their Second Annual Reports feel warranted in congratulating the members on the progress made during the year, in carrying out the objects for which the Society was formed. The details of this progress will be briefly brought before you under its various heads.

MEMBERS.

During the past year 7 life, 4 corresponding and 6 ordinary members—17 in all—have been added to the Roll; and in the same period six have withdrawn, and one died.

PAPERS.

Ten papers have been read since the last Annual Meeting, namely:—

Remarks on Certain Theories concerning the Orgin of Species—Dr. Sinclair.

The early History of the Province—Mr. Justice Parker.

The Natural Causes of Variety and Complexion in the Human Species—Dr. Hamilton.

A letter on the practical theory of Natural History—Mr C. F Hartt.

Observations on the Geology of the County of St John—Mr. Geo. Matthew.

Meteorology with summaries of observations made in St. John, between 1850 and 1852—Mr. G. Murdock.

General view of the Methods of Study of Natural History—Dr. Hamilton.

Reptiles of Acadia—Mr. C. F. Hartt.

Observations on Phrenology as a Science—Dr. Sinclair.

Ocean Drifts and Currents, and their effects upon Islands far removed from Continents—T. Matthew Jones. Esq , of Halifax

Of the above a number have been published in our Journals and the Canadian "Naturalist," and have been highly spoken of.

Mr. Murdock's paper on Meteorology is in course of being published by the Board of Agriculture in an appendix to their Report, where it will undoubtedly prove highly useful.

MUSEUM.

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without special notice the donation by Dr. Fiske of a nearly complete sett of the Anatidæ found in the Province. Mr. Hartt also has contributed a valuable collection of New England Reptiles, Molluscæ, and Marine Invertebrates, which had been carefully compared by him with the specimens in the Museum of Comparative Zoology at Cambridge, Mass., and, being now correctly labelled, will be serviceable in determining many species existing in the Lower Provinces. The Society is also much indebted to Mr. Jolly who has mounted its collection of Insects and presented a large number in addition obtained near this city. The Brazilian birds given by Mr. Ketchum have been stuffed and mounted by Mr. A. C. Otty, a corresponding member, in a manner very creditable to his taste and skill. The Curator has been enabled to make a few exchanges by which some Silurian fossils from Tennessee, and some valuable minerals from the Western States have been added to the Cabinet. As the Society has a large number of duplicate specimens of both minerals and fossils, numerous and valuable additions to the museum might be obtained by exchange, if members would make known this fact to friends abroad interested in natural science. The Council cannot conclude this part of their report without congratulating the Society on the acquisition of Mr. Hartt's very interesting and valuable collection of Devonian Fossils. from the "Fern Ledges" of Lancaster, numbering over 8,000. Through the energy of the Committee which undertook to procure funds, and the liberality of our fellow citizens, this purchase, it is hoped will not deprive the Society of any part of the small income which is so much needed for its ordinary purposes. The Council are informed that there is still about $100 wanting to complete the amount due Mr. Hartt, but they have no doubt that means will be contrived to raise that sum without drawing from the Society's ordinary funds.

The following summary of the contents of the museum will shew what has been ac-

Also a number of antiquities and curiosities, &c , and several rare vertebrates not included in the above.

With a view of increasing the museum by objects of Natural History from abroad the Council have had a circular to the ship owners and merchants of the Province prepared, urging them to assist the Society in this object, and giving full particulars of the best means of preserving such specimens as they may be able to secure.

LIBRARY.

The following additions have been made to the Library in volumes and pamphlets, viz.:—

	Presented.	Purchased.	Total.
Zoology	21	4	25
Botany	9	3	12
Geology and Mineralogy	4	7	11
General Science	21	11	32
Miscellaneous	16	"	16
Total,			96

Among these are several valuable donations. The Secretary of the Smithsonian Institution, with great liberality has presented 9 volumes treating of sea weeds, insects and shells, and meteorology. To Professor Stimpson we are indebted for a number of Brochures of which he is the author, and to the Secretary of the Maine Board of Agriculture for a large number of the 2nd report on the Natural History and Geology of Maine. The Natural History Society of Montreal continues to send its publications, this year in duplicate, and the Librarian has also received all the numbers of a new magazine published at Toronto, entitled "The British American" from the publisher.

FINANCES.

The following extract from the Treasurer's Report will exhibit the financial condition of the Society:—

DR.

To balance from last account	$22.19
" Member's subscription	198.88
" Received from Mr. Matthew (discount on books,)	1.77
	$222 84

CR.

By paid for Books,	$55 10
" Cases and Furniture for Museum,	26.5
" " " mounting Birds	30 00
" " " Stationary	32.74
" " " Rent of room	28.00
" " " Advertising	8 60
" " " Material for Museum	11.00
" " Express charges	1.63

Against this balance there is quite a large amount due for Books, Cases, &c , by which the income of the ensuing year is partly anticipated, so that the utmost prudence will be necessary to preserve the Society from debt, an object which the Council deem of vital importance to its prosperity; at the same time they have so constantly been made to feel the great inadequacy of the means hitherto at their disposal, properly to carry out the objects of the association, that they have been induced to make an application to the Government praying a small grant to enable the Society to extend and make more evident its usefulness It is earnestly hoped that a Province which already devotes so large a portion of its revenue to educational purposes will not refuse a grant to an association, which, if it could fully carry out its objects, must prove of inestimable value both to the character of the Province abroad and to those pursuing scientific studies at home. Even in this early stage the museum affords great facilities for studying the geology and mineralogy of Acadia, and if it can be duly increased and arranged, will be of incalculable advantage in any future survey of this Province, which may and probably will be found requisite. In reference to this subject the Council would remark that in the adjoining Republic and Provinces, large grants are annually made for similar objects; as for instance, in Canada, the last report of the Natural History Society of Montreal acknowledges a vote of $1000 a year to that institution alone

In conclusion the Council cannot but observe that the Society does not number among its members a great many individuals of the community whose wealth, talents and influence would, and as the Council think, ought to contribute largely to the success of such an association; which if it were only with a view to elevate the pursuits and refine the taste of our own youths, is surely entitled to every encouragement; want of time by some, and absence of scientific attainments by others, are pleaded as reasons for withholding their support, but if these pleas are good they might be urged by very many of the existing members to the same end. In fact there are few who cannot in some way, either by pecuniary aid, literary contributions, communication with friends abroad by letter, or in travel, or by mere personal influence and countenance, promote the welfare of the Society, and the praiseworthy object which it pursues.

The Council yield to the Society the offices and trust reposed in them for the year now closed with the fervent hope that the coming one may add to the Society's members and means at least an hundred fold.

DONATIONS TO THE MUSEUM IN 1863.

JANUARY—1863.

R. Hutchinson, Esq., Miramichi—Pyritous concretion from Sandstone—Point Miscou, Gloucester County, N. B.

C. M. Gove, Esq, St. Andrews—Dendrite on altered slate—St. Andrews, N. B.

FEBRUARY.

Miss Robinson, Port Stewart—A set of Irish Marine Algæ, Port Stewart, Ireland—collected by the donor.

G. F. Matthew—Mollusca of the Eocine period, Museum of Academy Natural Science, Philadelphia—Southern States.

Charles M'Lean, Lepreaux—Piece of lower jawbone of whale—Lepreaux.

Col. Charles Drury—Russian Coin.

R. Brittain—Fossil shells in shale, Mickley Colliery, England—Coral Limestone, Three Specimens Iron Ore—Felwell, England.

C. K. Fiske, M. D.—Native Aquatic Birds, (24) Collected by A. C. Otty.

H. C. Preston, M. D.—Limulus Polyphœmus—West Indies.

MARCH.

C R Matthew, et coll.—Ripple Marked Sandstone, Lower Carboniferous Bed—Norton, K. C.

J N. Moore, et coll —Lacerta Agilis, Land Lizard—Oil Works, Lancaster, St. John.

A. R. Ferguson—Piece of Iron, (Meteoric)—Bathurst. Upper Silurian Fossils—Dalhousie.

JULY.

Geo. Matthew, Esq, et coll.—Waterscoop from an old Indian Camping Ground—Harris' Cove, Hampton, K. C.

AUGUST.

G F. Matthew—Mammals, Reptiles, Fishes and Insects, collected by donor—Harris' Cove, Hampton, K. C.

NOVEMBER.

S S. Littlehale—Copper Ore, Union Mine, Collected by James Littlehale—Copperopolis, San Joaquin Co., a.

G. C. Carman, et coll —Snake—Dartmouth, Nova Scotia.

J. Howe, Esq —Flying Squirrel.

Edward Allison, Esq —Head Dress, Calabash and Casinet—Demerara, South America.

O. G Harbell—Salamander, Fish and Frog, Lily Lake; Brook Trout and Young, Salmon Trout, Loch Lomond, 2nd Lake; Perch, Terreo Lake.

C. R. Matthew—P aster Stands for Minerals.

Mrs. Whipple—Sh lls, (200 specimens) ... tle Alcholic ...

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donor—Cambridge. Mass. Seven specimens of New England, Turtles, of three species, named and arranged; collected by donor—Cambridge, Mass. Reptiles, Insects and Shells; collected by donor—Nova Scotia and New Brunswick.

J. W. Hartt, and —. Seaman—Fossil Tree Sigillariæ with stigmaria roots. Collected by donor—South Joggins, N. S.

R. C. Jolly—200 Insects. Collected by donor—New Brunswick.

R. P. Starr—Several butterflies, moths, etc. In part collected by a lady at Sussex Vale—New Brunswick.

Chipman Skinner—11 specimens Reptiles, 6 specimens Insects. Collected by donor—Nova Scotia.

R. Brittain—5 specimens Fossils, 2 do. Concretions, 2 do Minerals. Collected by donor—Lesmahago and Limerick. Gas Carbon, Gas-Works Collected by donor—St. John

Rev. Wm. Elder—Galena and Barytes—Fry's Island.

P. A. Scott, R N.—Fishes. Collected by donor—Atlantic Coast of Nova Scotia.

DONATIONS TO THE LIBRARY.

From the Author.—The Naturalist in Bermuda, J. M. Jones, Esq.

C. F. Matthew—Petrefactenbunch of Dr. F. A. Schmidt.

R. Jardine, Esq.—Third Report of Board of Agriculture.

Smithsonian Institute—Smithsonian Report of 1860 and 1861; Nereis Boreali Americana, Part 1, 2 and 3; Synopsis of North American Lepidaptera, Part 1; Synopsis of North American Coleoptera, Part 1; Synopsis of North American Neuroptera, Part 1; Monograph North American Diptera, Part 1; Cheilist of North American Shells; Lectures on Mollusca; Catalogue of Publications; Eulogies on Felton, and Hon. S. A. Douglas.

From the Author, W. Stimpson—Shells of New England; Crustacea and Echinodermata of Pacific Shores of North America; Notes on North American Crustacea, in Museum of Smithsonian Institute.

Papers published by Boston Natural History Society. American Journal of Science, Academy of Natural Sciences, Philadelphia.

Reptiles of North Pacific exploring Expedition; P o ron us descript onis anamalium evertobratorum, &c.

Dr. ...

BULLETIN

OF THE

NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

No. XX.

VOLUME IV. PART V.

PUBLISHED BY THE SOCIETY

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